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ABSTRACT

This supplementary mathematics textbook is designed to teach pupils in the intermediate grades about the vocabulary and use of the metric system of measurement. The book limits exploration to the units of measurement for length, capacity, mass, temperature, area, and volume, with only the following prefixes considered: kilo, hecto, deka, deci, centi, and milli. Sections of this document include: metric rulers; length (the meter); length (the centimeter); perimeter; length (the millimeter); length (the kilometer); area; volume; capacity; mass; capacity and mass; temperature; converting metric units of length; converting metric units; metric mania; relationships; and my metric measurements. (MP)

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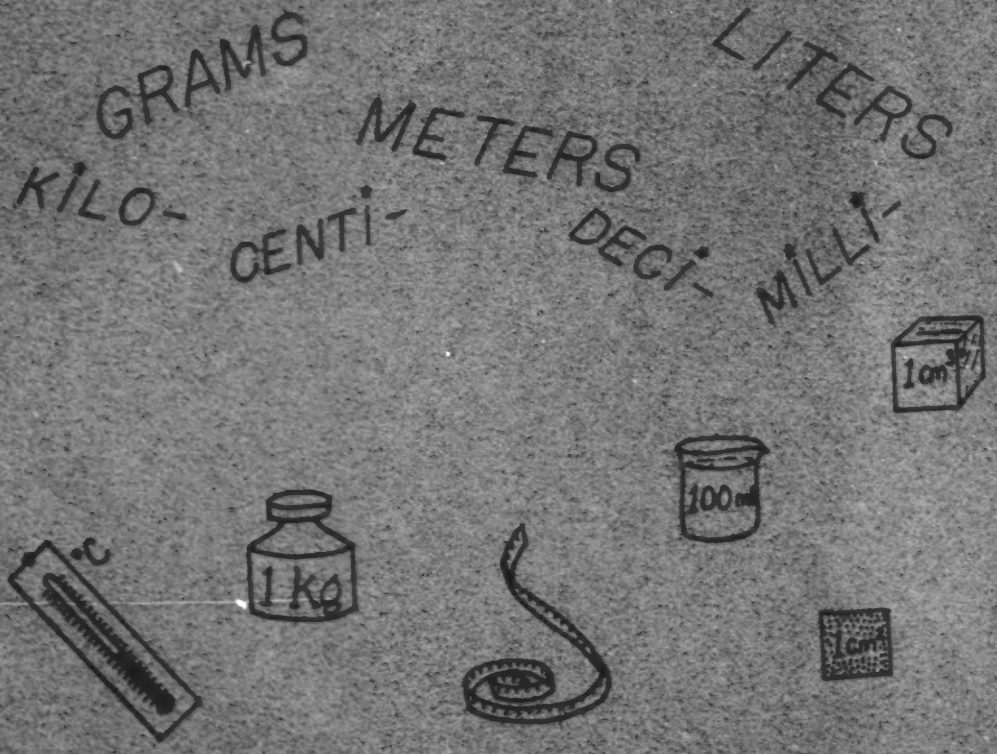
# MEASURING IN METRIC



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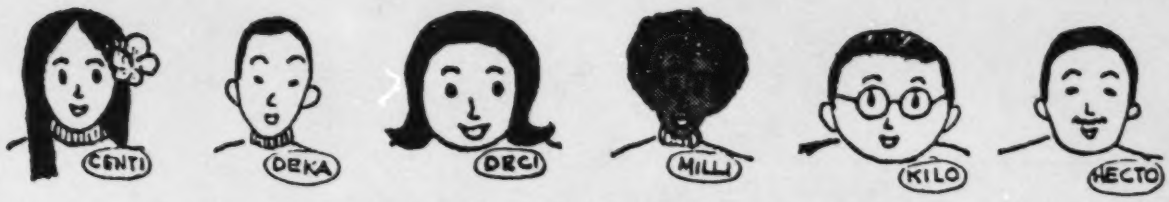
1979

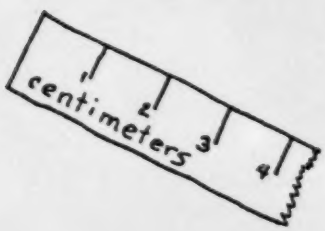
## TO THE STUDENT:

In this unit you will be learning about the metric system of measurement. It is based upon a unit of length called the meter. The meter was originally defined as one ten-millionth of the distance from the equator to the North Pole. Since then, it has been redefined in terms of a given number of wavelengths of light from the element krypton.

Activities, games and exercises will help you to become familiar with the metric units of length, area, volume, mass, capacity and temperature. Also, in this unit you will meet the six Metric Kids. They appear throughout each chapter to point out important ideas. They also challenge you with metric "puzzlers" at the beginning of each section.




By the end of this unit, you should feel so comfortable with the metric system that you'll wonder why anybody EVER used the English system of feet, inches, etc.!



? liters

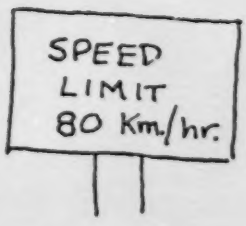
A PIECE OF CHALK WEIGHS ABOUT 10 GRAMS!

km

m

$3\,cm^2 = \underline{?}\ mm^2$

TODAY'S TEMP:
25°C



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# THE *METRIC SYSTEM* FOR

# LENGTH
# AREA
# VOLUME
# CAPACITY
# MASS
# TEMPERATURE

Over 90% of the world uses the metric system.

This system is called SI, International System of Units.

We need to be prepared to use the metric system when the United States officially goes metric.

The metric system is based on a decimal system just as our money and number systems....

....so there will be a review of skills with decimal numbers throughout this booklet.

The metric units commonly used for length, area, volume, capacity, mass, and temperature measurements will be studied.

Six frequently used prefixes and their meanings

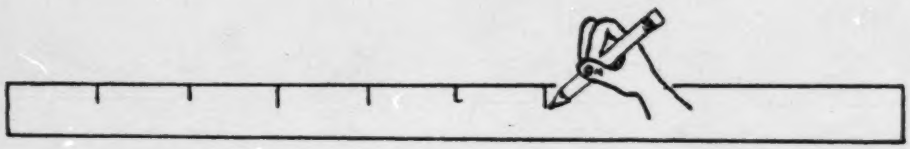
| | | |
|---|---|---|
| *kilo-* | one thousand | 1000 |
| *hecto-* | one hundred | 100 |
| *deka-* | ten | 10 |
| *deci-* | one-tenth | 0.1 |
| *centi-* | one-hundredth | 0.01 |
| *milli-* | one-thousandth | 0.001 |

# METRIC RULERS

Meter

The meter is a basic unit of the metric system. The meter is about 1 yard long.

Cut off 1 meter length of adding machine tape. Mark 10 equal parts. Each part is 1 decimeter (1 *dm*) long.



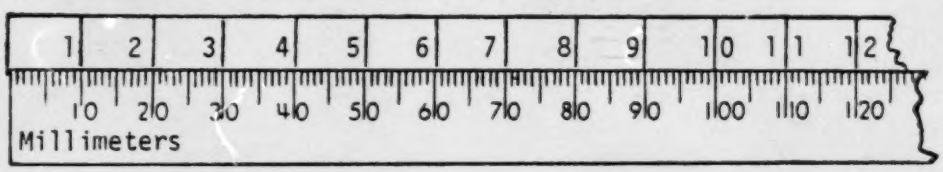
Centimeter

Cut off the centimeter ruler on the right. Paste it on a strip of cardboard.

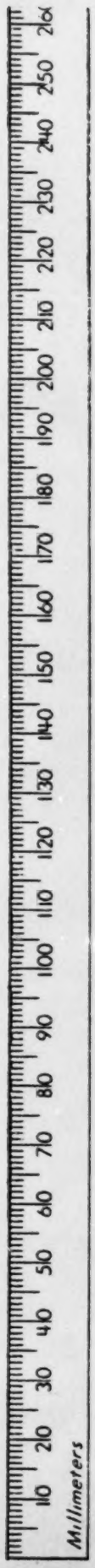
Millimeter

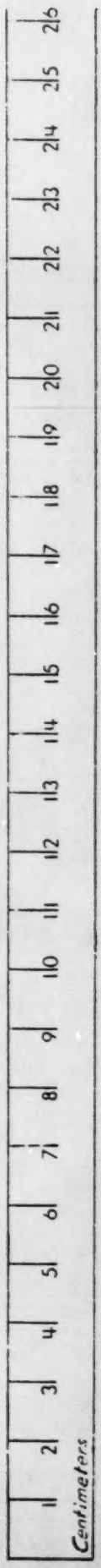
Cut off the millimeter ruler. Paste it on a strip of cardboard.

Lay the millimeter ruler along the centimeter ruler.

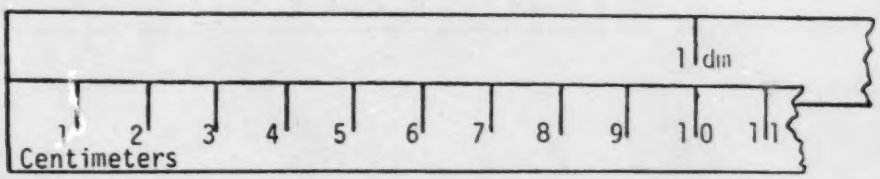



1. 4 *cm* = _____ *mm*
2. 5 *cm* = _____ *mm*
3. 2.5 *cm* = _____ *mm*
4. 3.2 *cm* = _____ *mm*
5. 1 *cm* = _____ *mm*
6. 27 *cm* = _____ *mm*
7. 15.6 *cm* = _____ *mm*
8. 10.9 *cm* = _____ *mm*
9. 23.1 *cm* = _____ *mm*
10. 0.7 *cm* = _____ *mm*



Lay the centimeter ruler along a meter ruler.




11. 10 *cm* = _____ *dm*

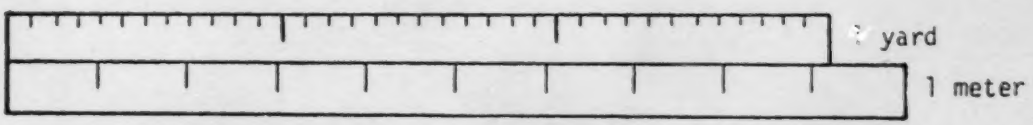
12. 2 *dm* = _____ *cm*

13. 1 *m* = _____ *cm*

14. 1 *m* = _____ *dm*

15. 10 *dm* = _____ *cm*

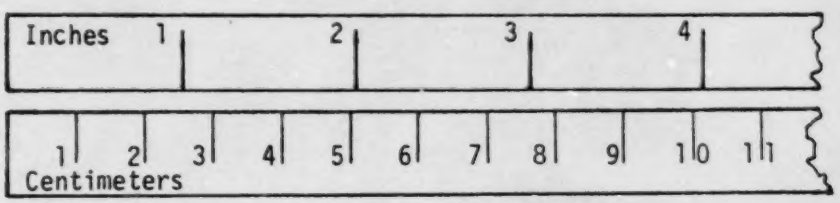
Lay the meter ruler along a yardstick.




16. One _____ is longer than one _____.

17. One _____ is about _____ longer than one yard.

Lay the centimeter ruler along an inch ruler.

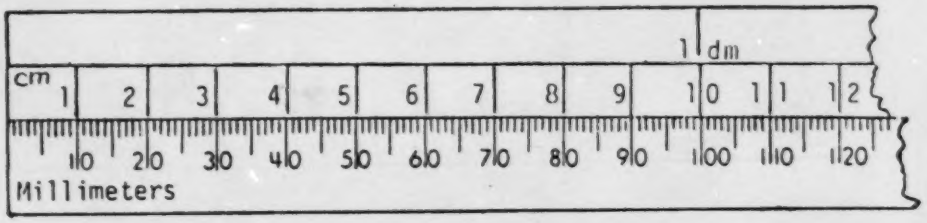



18. One _____ is longer than one _____.

19. One inch is about _____ centimeters.

20. 5 *cm* is about _____ inches.

Lay the centimeter ruler and the millimeter ruler along the meter ruler.




21. _____ *cm* = 1 *dm*

22. _____ *mm* = 1 *dm*

23. _____ *mm* = 1 *cm*

24. _____ *cm* = 1 *m*

25. _____ *mm* = 1 *m*

Name five objects that you would measure with a meter ruler.

_____ _____

_____ _____

_____

Name five objects that you would measure with a centimeter ruler.

_____ _____

_____ _____

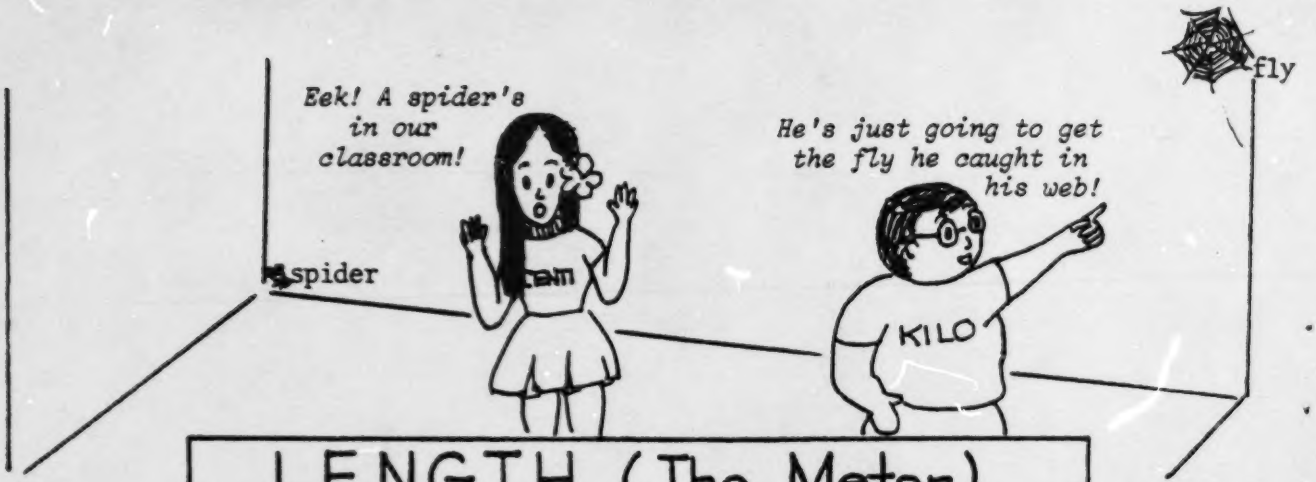
_____

Name five objects that you would measure with a millimeter ruler.

_____ _____

_____ _____

_____




# LENGTH (The Meter)

1. For each item listed below, estimate its length by writing "about 1 meter," "longer than 1 meter," or "shorter than 1 meter." Use your meter ruler to check your answer.

   a. Length of a crutch _____

   b. Distance around this page _____

   c. Width of a wheelchair _____

   d. Length of your arm _____

   e. Distance around your head _____

   f. Length of one of the teacher's strides _____

   g. Height of light switch from the floor _____

   h. Length of your outstretched arms _____

2. For each item listed below, estimate its length in meters; then measure to the nearest meter.

| ITEM | ESTIMATE | MEASUREMENT |
|---|---|---|
| a. Height of your desk | | |
| b. Width of the door | | |
| c. Height of the door knob | | |
| d. Length of the chalktray | | |
| e. Width of a window | | |
| f. Height of the chalk tray | | |

"The paper meter is handy to have," said Kilo. "It's a lot easier to carry around than a meter stick!"

"Yeah," agreed Deci, "but I wouldn't carry it with me wherever I went. Besides, I found out something--a meter is about the length of both my arms! That's how I got all my estimates for problem 2 so close!"

*I don't have to stretch as much as you do because my arms are longer!*

3. Use your paper meter to help you estimate how far apart your arms should be to show a length of one meter.

4. Estimate the following to the closest meter. Then check how close you were by actually measuring.

| | Estimate | Measurement |
|---|---|---|
| a. Length of bulletin board | _____ | _____ |
| b. Width of overhead projector screen | _____ | _____ |
| c. Length of blackboard | _____ | _____ |

*5. Another "body meter" is the teacher's stride. Measure a distance of 10 meters with a trundle wheel. Count the number of paces it takes your teacher to walk 10 meters. Repeat it two more times.

First trial _____ paces in 10 meters

Second trial _____ paces in 10 meters

Third trial _____ paces in 10 meters

Average _____ paces in 10 meters

6. Estimate the number of revolutions of the big wheel of a wheel chair for each of the following. Then check to see how close you were.

| | Estimate | Check |
|---|---|---|
| a. 10 meters | _____ | _____ |
| b. 15 of the teacher's strides | _____ | _____ |
| c. Length of the hall outside your classroom | _____ | _____ |
| d. Distance to the door of the principal's office from the door of your classroom | _____ | _____ |

*Trundle wheel needed for this activity.

*7. Mark the length of one revolution of the big wheel of a wheel chair on the floor. Use a meter ruler or a trundle wheel to measure this length to the nearest 0.1 meter. _____ *m*

8. Imagine how long each object below is in real life. Circle the length that is closest to what you imagined.

| | | | |
|---|---|---|---|
| a. Pontiac Firebird | 2 *m* | 5 *m* | 15 *m* |
| b. Your school bus | 1 *m* | 4 *m* | 18 *m* |
| c. Motorcycle | 2 *m* | 4 *m* | 6 *m* |
| d. Tour bus | 5 *m* | 17 *m* | 140 *m* |
| e. Length of a ping pong table | 2 *m* | 4 *m* | 10 *m* |
| f. Height of a coconut tree | 5 *m* | 15 *m* | 25 *m* |
| g. Length of an outrigger canoe | 2 *m* | 4 *m* | 8 *m* |
| h. Width of sidewalk in front of school | 1 *m* | 3 *m* | 5 *m* |
| i. Height of flag pole in school yard | 1 *m* | 5 *m* | 10 *m* |

9. Name objects that are about 1 meter long.

a. In your home _____

b. In this classroom _____

c. Around the school yard _____

d. In sports _____

e. From parts of a building _____

f. Any other one meter length _____

10. **** *Estimate the length in meters of the shortest path the spider can take to reach the fly.*

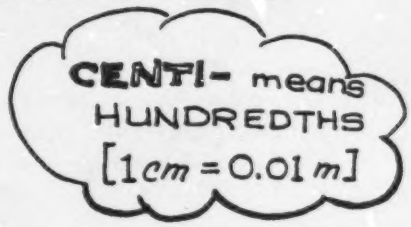
*Trundle wheel needed for these activities.

*Hey, Deka! There goes a two-centimeter worm crawling the width of this room. It crawls ten times its length in a minute.*

*Yeah, I know what time it will be when it gets to the other end, Kilo.*

# LENGTH (The Centimeter)

The centimeter is a commonly used unit of length. The meter is separated into one hundred centimeters.




Here are some familiar objects which have measurements of about one centimeter:

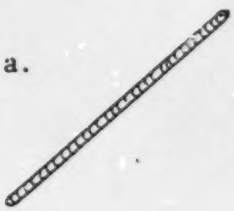
The width of a piece of chalk

The width of the base of the pointer finger

The diameter of the head of a thumbtack

1. Look at each worm below. Estimate the length of each worm to the nearest centimeter. Then, using your centimeter ruler, measure each worm to the nearest centimeter. Write the difference between your estimate and the actual measurement.

a.



Estimate _____

Measurement _____

Difference _____

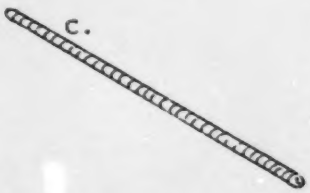
b.

Estimate _____

Measurement _____

Difference _____

c.

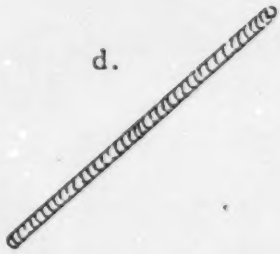


Estimate _____

Measurement _____

Difference _____

d.



Estimate _____

Measurement _____

Difference _____

e.

Estimate _____

Measurement _____

Difference _____

2. The sum of the measurements of all the worms is _____.

   The longest worm is _____ *cm* longer than the shortest worm.

3. Draw two worms with each of the following measurements. Draw the first worm for each problem without a ruler. Use your centimeter ruler to draw the second worm for each problem.

   a. 3 *cm*

   b. 6 *cm*

   c. 4 *cm*

   d. 5 *cm*

4. The worms you have been measuring are called straightworms. Here are some wiggleworms. Estimate the length of each wiggleworm to the nearest centimeter. Then use string to help you measure each worm. Write the difference between your estimate and the actual measurement.

   a.

   b.

   c.

5. Pick a partner and estimate, then measure the following objects to the nearest centimeter.

| | REGARDING PARTNER | | REGARDING MYSELF | |
|---|---|---|---|---|
| | ESTIMATE | MEASUREMENT | ESTIMATE | MEASUREMENT |
| a) length of elbow to tip of fingers | | | | |
| b) length of middle finger | | | | |
| c) around wrist | | | | |
| d) around head | | | | |
| e) around waist | | | | |
| f) length of workbook | | | | |
| g) width of workbook | | | | |

6. Without a ruler, draw a line segment which is about 10 *cm* long. Then measure to the nearest centimeter and record your error. Try this again until your error is within 1 centimeter.

| | MEASUREMENT | ERROR |
|---|---|---|
| FIRST TRIAL | | |
| SECOND TRIAL | | |
| THIRD TRIAL | | |

7. ****What time did the 2-cm worm reach the other end of the room?*

*The distance around my head is 1.4 cm less than Deci's.*

*It is 3.5 cm more around my head than Deka's.*

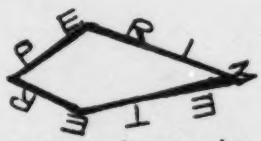
*The distance around Deci's head is 2.5 cm greater than around mine.*

*The distance around Hecto's head is 1.4 cm greater than around mine.*

*The distance around my head is 2.2 cm more than around Centi's.*

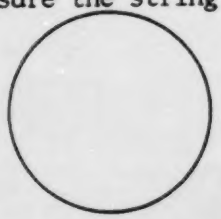
# PERIMETER

The perimeter of a figure is the distance completely around it, along its edge.



1. Find the perimeter of each object below to the nearest centimeter by doing the following: Use string to go completely around the object, then measure the string to the nearest centimeter.

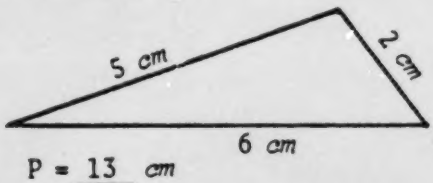
a.



b.

2. Measure each side of the polygon to the nearest centimeter. Find the perimeter (P) of each polygon.

Example:



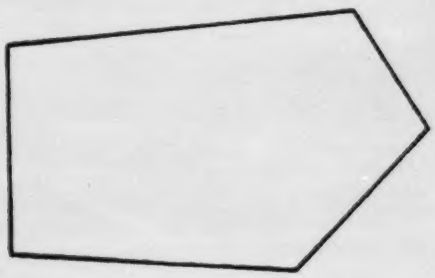

2 cm
5 cm
+ 6 cm
13 cm

P = 13 cm

a.

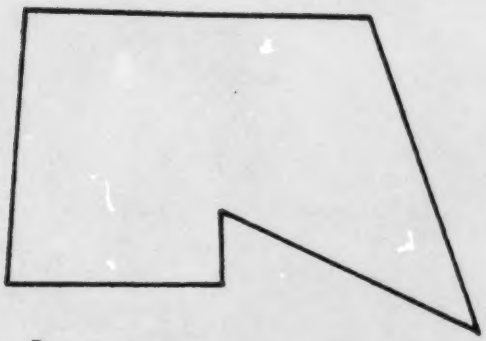
P=___ cm

b.



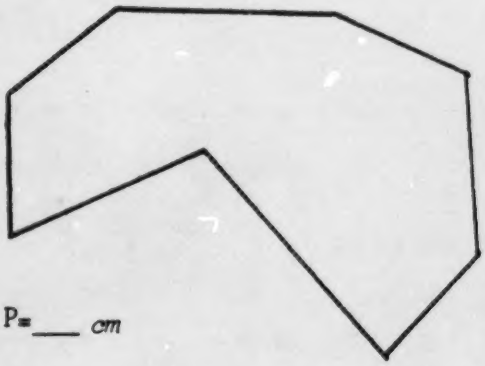
P=___ cm

c.



P=___ *cm*

d.



P=___ *cm*

3. Draw polygons whose sides are not all the same length.

a. 3 sides; perimeter 12 *cm*

b. 5 sides; perimeter 20 *cm*

4. Estimate the perimeter. Then measure to the nearest centimeter.

| OBJECT | ESTIMATE | MEASUREMENT |
|---|---|---|
| a. This page | | |
| b. The top of your desk | | |
| c. Top of wastepaper basket | | |
| d. Top of chalkboard eraser | | |

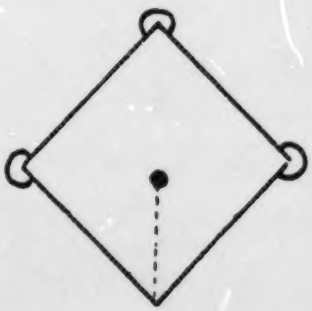
5. Estimate the perimeter. Then measure to find the perimeter. Write answers to the nearest meter.

| | Estimate | Measurement |
|---|---|---|
| a. Top of teacher's desk | _____ *m* | _____ *m* |
| b. A page of the newspaper | _____ *m* | _____ *m* |
| c. The American flag on the pole in the school yard | _____ *m* | |

6. How could you find the perimeter of the school's flag?

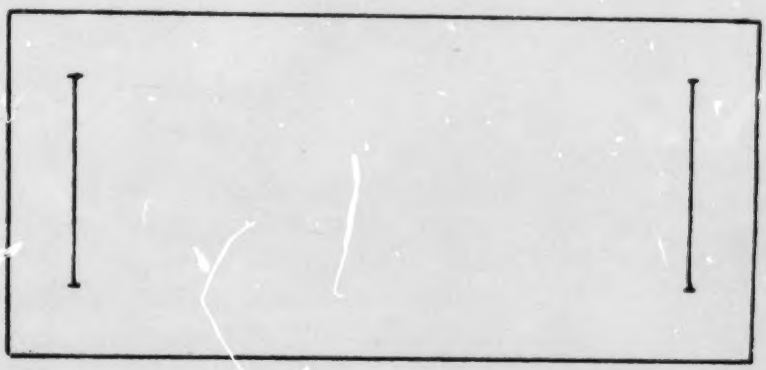
7. Measure to find the perimeter in real life. Use the scale: 1 *cm* represents 10 *m*.

Baseball diamond



P=_____ *m*

Football field

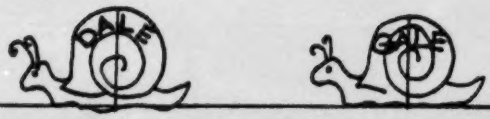


P=_____ *m*

Olympic-size swimming pool

P = _____ *m*

8. **** *What is the measurement of each person's head?*



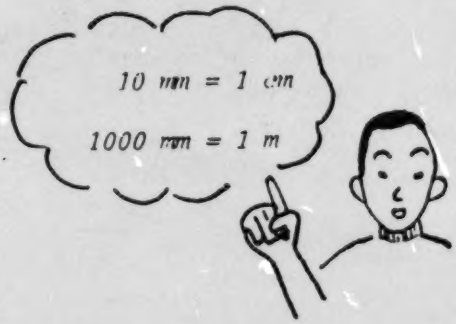

# LENGTH (The Millimeter)

Which snail is taller--Dale or Gale?

Measure the heights of both snails to the nearest centimeter. Aren't they both about 1 centimeter tall?

Sometimes, more exact measurements are needed. This is accomplished by using smaller units of length. The smallest unit of length most commonly used in the metric system is the millimeter. One centimeter is equal to 10 millimeters.

*A millimeter's shorter than a centimeter.*



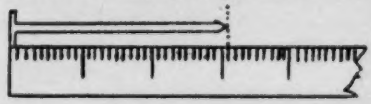

Here are two things you may use to help you remember just how long one millimeter is:

The wire in a paperclip is about 1 millimeter thick.

A dime is about 1 millimeter thick.

1. Estimate the lengths of the nails.

Measure the nails to the nearest millimeter and complete the chart.



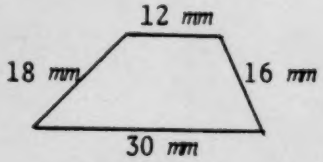
| | ESTIMATE | MEASUREMENT |
|---|---|---|
| Nail A | | |
| B | | |
| C | | |
| D | | |
| E | | |

2. Measure the diameter and the thickness of the following coins to the nearest millimeter.

| COIN | DIAMETER MEASUREMENT | THICKNESS |
|---|---|---|
| Penny | | |
| Nickel | | |
| Dime | | |
| Quarter | | |

3. Measure the sides of each polygon to the nearest millimeter. Then find the perimeter of each polygon.

Example:



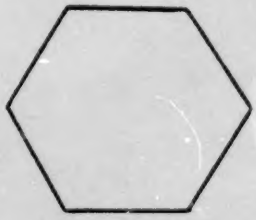

12 mm
16 mm
30 mm
+ 18 mm
76 mm

P = 76 mm

a.

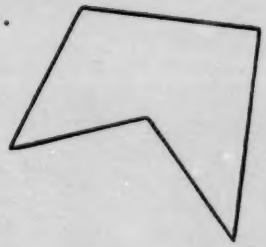
P = _____ mm

c.



P = _____ mm

b.



P = _____ mm

d.

P = _____ mm

4. More estimations! Estimate the following, then measure to the nearest millimeter and complete the chart.

| | ESTIMATE | MEASUREMENT | DIFFERENCE |
|---|---|---|---|
| a. the width of your small finger | | | |
| b. the length of your pencil point | | | |
| c. the length of your thumbnail | | | |
| d. the distance between the horizontal lines on your folder paper | | | |
| e. the length of this line segment: __ | | | |

5. REVIEW: ADDITION AND SUBTRACTION OF DECIMALS

Add or subtract as indicated.

a. 5.3 + 2.7 + 6.8 = _____

b. 14.2 + 1.73 + 2.917 = _____

c. 25.92 - 15.48 = _____

d. 1.7 - 0.23 = _____

e. 916.04 - 63.77 = _____

f. 26 + 7.602 + 51.3 + 5.1 = _____

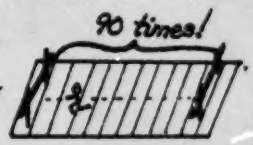
6. ***Find the heights of the two snails to the nearest mm.*

****A snail was at the bottom of a bottle and tried to climb out. Every day he climbs 30 mm, but at night he slips back 20 mm. If the bottle is 230 mm deep, how long would it take for the snail to get out?*

KILO- means one thousand
1000 m = 1 km

# LENGTH (The Kilometer)

Long distances are measured in *kilometers*. (Remember: *Kilo-* means *one thousand*, so *1 km = 1000 m*.) One kilometer is approximately equal to the lengths of 90 football fields!

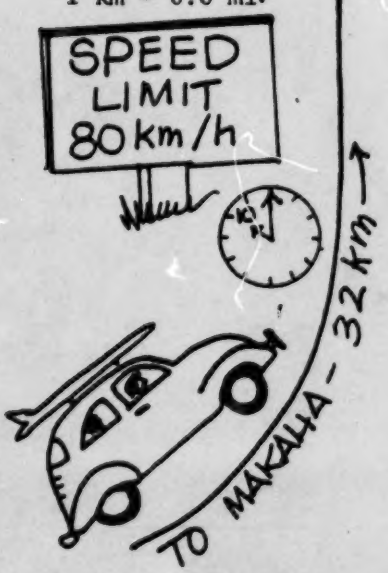



In the problem below, you will discover a way to change distances given in miles to distances given in kilometers.

1. Discover the pattern to complete the table below.

| MILES | KILOMETERS |
|---|---|
| 10 | 10 + 5 + 1 = 16 |
| 20 | 20 + 10 + 2 = 32 |
| 30 | 30 + 15 + 3 = 48 |
| 40 | |
| 50 | |
| 60 | |
| 70 | |
| 80 | |
| 90 | |
| 100 | 100 + 50 + 10 = 160 |
| 110 | |
| 120 | |

about
1 km = 0.6 mi.



## DISTANCES IN KILOMETERS ON MAUI

| PLACE | Haleakala | Hana | Kaanapali | Kahului | Kihei | Lahaina | Paia |
|---|---|---|---|---|---|---|---|
| Hana | 94 | x | 128 | 83 | 94 | 122 | 75 |
| Kaanapali | 86 | 128 | x | 46 | 38 | 6 | 59 |
| Kahului | 42 | 83 | 46 | x | 14 | 37 | 14 |
| Kihei | 53 | 94 | 38 | 14 | x | 32 | 26 |
| Lahaina | 80 | 122 | 6 | 37 | 32 | x | 53 |
| Paia | 37 | 75 | 59 | 14 | 26 | 53 | x |
| Wailuku | 46 | 96 | 40 | 8 | 14 | 34 | 19 |

2. Look at the distance chart above and give the distance in kilometers between the following places. The first one has been done for you.

a. Lahaina and Kaanapali *6 km*

b. Wailuku and Kahului _____

c. Kihei and Paia _____

d. Haleakala and Lahaina _____

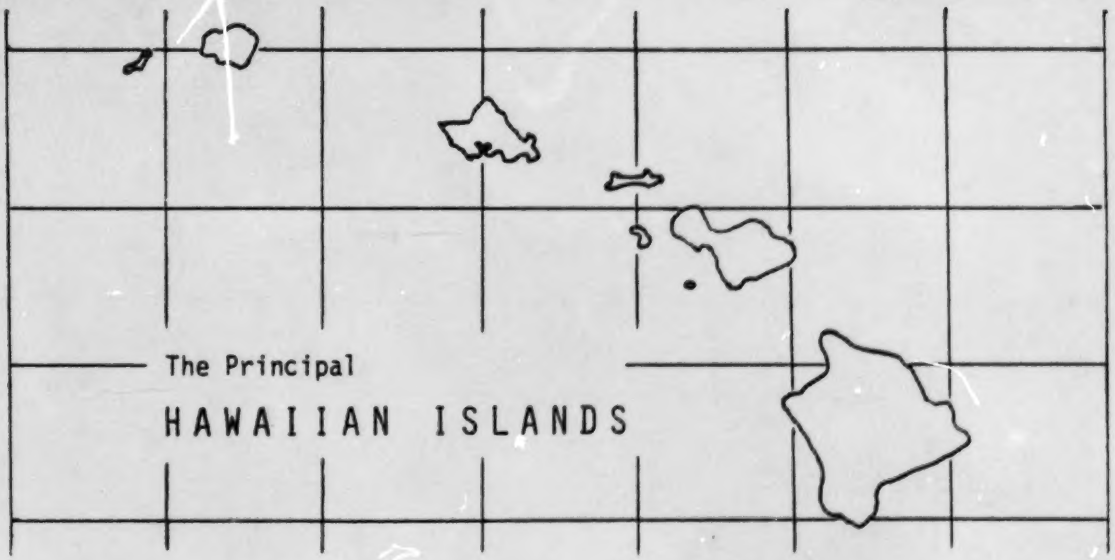
e. Kahului and Hana _____

f. Kaanapali and Wailuku _____

Find the five longest different distances from the chart above. Arrange the five numbers from the greatest to the least.

_____ _____ _____

_____ _____




3. Given below is a distance chart for the Hawaiian Islands to the nearest ten miles. Use your discovery in exercise 1 to write the distances in kilometers. The distance in kilometers from Maui to Lanai is done for you.

DISTANCES BETWEEN THE HAWAIIAN ISLANDS

| | HAWAII | KAUAI | LANAI | MAUI | MOLOKAI | OAHU |
|---|---|---|---|---|---|---|
| KAUAI | 260 mi. | X | 170 mi. | 190 mi. | 150 mi. | 80 mi. |
| LANAI | 70 mi. | 170 mi. | X | 10 mi. | 10 mi. | 50 mi. |
| MAUI | 30 mi. | 190 mi. | 10 mi. 16 km | X | 10 mi. | 70 mi. |
| MOLOKAI | 90 mi. | 150 mi. | 10 mi. | 10 mi. | X | 30 mi. |
| OAHU | 140 mi. | 80 mi. | 50 mi. | 70 mi. | 30 mi. | X |
| NIIHAU | 300 mi. | 20 mi. | 210 mi. | 230 mi. | 190 mi. | 120 mi. |

4. The road distance from Haleiwa to Waimea is about 8 *km*. 8 kilometers is about 5 miles. Look at the map below and name two other locations on Oahu that are about 8 *km* apart.

a. _____ to _____

b. _____ to _____

5. Take a field trip on the bus. Go 1 kilometer in different directions from the school. Describe each route taken to go 1 kilometer.

a. Start at school _____

b. Start at school _____

c. Start at school _____

d. Draw a sketch of each route taken. On the sketch write names of streets on the route. Write a description of each place about 1 kilometer from your school.

e. Describe three places that you think are about 2 kilometers from your school.

6. Estimate the number of kilometers from your school to each of these places.

a. Aloha Tower _____ c. Punchbowl _____

b. Honolulu International Airport _____ d. Ala Moana Shopping Center _____

7. Project: Ask your bus driver to tell you the number of miles from your home to school. Multiply this number by 1.6 to find the number of kilometers. The distance from your home to school is _____ kilometers.

8. Project: Measure one revolution of the large wheel of a wheel chair to the nearest centimeter.

a. 1 revolution of the large wheel = _____ *cm*

b. 1 kilometer = _____ *m* 1 meter = _____ *cm*

So, 1 kilometer = _____ x _____ *cm*

c. How many revolutions of the big wheel are needed to go 1 kilometer?

_____ revolutions

9. Project:

a. Measure the length of a crutch to the nearest centimeter.

1 crutch = _____ *cm*

b. How many crutches placed end-to-end are needed to reach 1 kilometer? _____

10. **** *What time did they reach Makaha?*

*The basic unit of length is the meter.*

*The centimeter, 100 cm = 1 m*

*The millimeter, 1000 mm = 1 m*

*The kilometer, 1000 m = 1 km*

*Other commonly used units of length are-*

# LENGTH

In the metric system, the standard unit for measuring length is the meter. For measuring shorter or longer distances, other units are used. These units are closely related to the meter. For example, one *centi*meter is *one hundredth* of a meter. The relationship of these units to the meter is given by their prefixes:

KILO- means THOUSAND, so *1 km* = _____ *m*

HECTO- means HUNDRED, so *1 hm* = _____ *m*

DEKA- means TEN, so *1 dam* = _____ *m*

DECI- means TENTH, so *1 dm* = _____ *m*

CENTI- means HUNDREDTH, so *1 cm* = _____ *m*

MILLI- means THOUSANDTH, so *1 mm* = _____ *m*

The table below summarizes the relationship between the different metric units of length and the meter.

| *number of meters* | 1000 | 100 | 10 | 1 | 0.1 | 0.01 | 0.001 |
|---|---|---|---|---|---|---|---|
| *metric unit* | kilometer | hectometer | dekameter | meter | decimeter | centimeter | millimeter |

1. Fill in the blanks.

deci- means _____, so 1 *dm* = _____ *m*

hecto- means _____, so 1 *hm* = _____ *m*

milli- means _____, so 1 *mm* = _____ *m*

kilo- means _____, so 1 *km* = _____ *m*

centi- means _____, so 1 *cm* = _____ *m*

deka- means _____, so 1 *dam* = _____ *m*

2. Now try these:

centi- means _____, so 1 centidollar = _____

deci- means _____, so 1 decidollar = _____

kilo- means _____, so 1 kilodollar = _____

milli- means _____, so 1 millidollar = _____

3. Fill in.

milli- means _____, so _____ millimeters = 1 meter

centi- means _____, so _____ *cm* = 1 *m*

deci- means _____, so _____ *dm* = 1 *m*

4. Fill in the blank with a metric prefix.

a. 0.01 pede ⟶ _____ pede

b. 100 r ⟶ _____ r

c. 0.001 cent ⟶ _____ cent

d. 1000 watt ⟶ _____ watt

5. Estimate and measure the given line segments to the nearest specified units.

| LINE SEGMENT | ESTIMATE | MEASUREMENT |
|---|---|---|
| | _____ *cm*<br>_____ *mm* | _____ *cm*<br>_____ *mm* |
| | _____ *cm*<br>_____ *mm* | _____ *cm*<br>_____ *mm* |
| | _____ *cm*<br>_____ *mm* | _____ *cm*<br>_____ *mm* |

6. Circle the most sensible measure.

a. Height of a woman

160 *mm* 160 *cm* 160 *m* 160 *km*

b. Length of a bowling alley

18 *mm* 18 *cm* 18 *m* 18 *km*

c. Length of a new pencil

192 *mm* 192 *cm* 192 *m*

d. Length of a new piece of chalk

6 *mm* 6 *cm* 6 *m*

e. Height of a big wave on the North Shore
5 *mm* 5 *cm* 5 *m* 5 *km*

f. Width of the street in front of your school
12 *mm* 12 *cm* 12 *m* 12 *km*

7. Circle the most appropriate unit for measuring:

| | | | |
|---|---|---|---|
| a. Length of your front yard | *cm* | *m* | *km* |
| b. Width of a thumbtack head | *mm* | *cm* | *m* |
| c. Length of H-1 freeway | *cm* | *m* | *km* |
| d. Deepest end of a swimming pool | *cm* | *m* | *km* |
| e. Length of Wailua River | *cm* | *m* | *km* |

8. Fill in the blank with the most appropriate unit: *cm*, *m*, or *km*.

a. A car is 5 _____ long.

b. A floor lamp is 150 _____ tall.

c. A rug is 2 _____ wide.

d. It is 15 _____ from Kailua to Honolulu.

e. A safety pin is 3 _____ long.

9. From the list of items below each problem, underline those that have the appropriate measurement:

a. between 2 *m* and 3 *m*

Width of a door

Height of a giraffe

Length of a bed

b. between 10 *cm* and 30 *cm*

Diameter of a dinner plate

Length of a football

Height of a TV set

c. between 10 *mm* and 70 *mm*

Length of a flashlight

Diameter of a penny

Width of a dollar bill

d. between 3 *m* and 7 *m*

Height of a door

Length of a whale

Height of a mango tree

10. Write the name or symbol for the common metric units of length.

| | NAME OF UNIT | SYMBOL | | NAME OF UNIT | SYMBOL |
|---|---|---|---|---|---|
| a. | _____ | *m* | c. | _____ | *mm* |
| b. | centimeter | _____ | d. | _____ | *km* |

11. Without a ruler, draw a line segment about 60 *mm* long. Measure to the nearest millimeter and record your error. Try this again until your error is within 5 *mm*.

| | MEASUREMENT | ERROR |
|---|---|---|
| FIRST TRIAL | | |
| SECOND TRIAL | | |
| THIRD TRIAL | | |

12. For each description below write

M if more than 1 meter
A if about 1 meter
L if less than 1 meter

_____ a. Your teacher's height
_____ b. The wire of a paper clip when straightened
_____ c. The width of the largest window in your classroom
_____ d. The height of your classroom
_____ e. The perimeter of the dial of a telephone
_____ f. The distance from one corner of your classroom to the opposite corner along the floor
_____ g. The length of the longest hair on your head
_____ h. The perimeter of a tray in the cafeteria

13. For each description below write

M if more than 1 centimeter
A if about 1 centimeter
L if less than 1 centimeter

_____ a. The thickness of the glass of a drinking glass
_____ b. The thickness of 100 pages of your mathematics book
_____ c. The width of a tire on a wheel chair

_____ d. The length of a grain of rice

_____ e. The thickness of a meter stick

_____ f. The distance across one of your front teeth

_____ g. The length of a thumb tack

_____ h. The height of the letter B

_____ i. The smallest 1 on your classroom calendar

14. For each description below write

M if more than 1 millimeter
A if about 1 millimeter
L if less than 1 millimeter

_____ a. The thickness of a finger nail

_____ b. The thickness of the cover of your mathematics book

_____ c. The diameter of the wire of a paper clip

_____ d. The diameter of the spoke of a wheel of a wheel chair

_____ e. The thickness of one hair from your head

_____ f. The diameter of a button on a shirt

_____ g. The thickness of 100 pages of your mathematics book

_____ h. The height of the letter a

15. Find on a wheel chair, in the classroom, or around your school one object for each of these lengths.

a. Much more than 1 meter

b. Much less than one meter

c. Much more than 1 centimeter

d. Much less than 1 centimeter

e. Much more than 1 millimeter

f. Much less than 1 millimeter

16. Multiply the following:

a. $\begin{array}{r} 2.34 \\ \times\ \ 5 \\ \hline \end{array}$

b. $\begin{array}{r} 36.1 \\ \times\ 1.2 \\ \hline \end{array}$

c. $\begin{array}{r} 20.82 \\ \times\ \ 0.7 \\ \hline \end{array}$

d. $\begin{array}{r} 3.9 \\ \times\ 2.3 \\ \hline \end{array}$

e. $\begin{array}{r} 25.75 \\ \times\ \ 2.5 \\ \hline \end{array}$

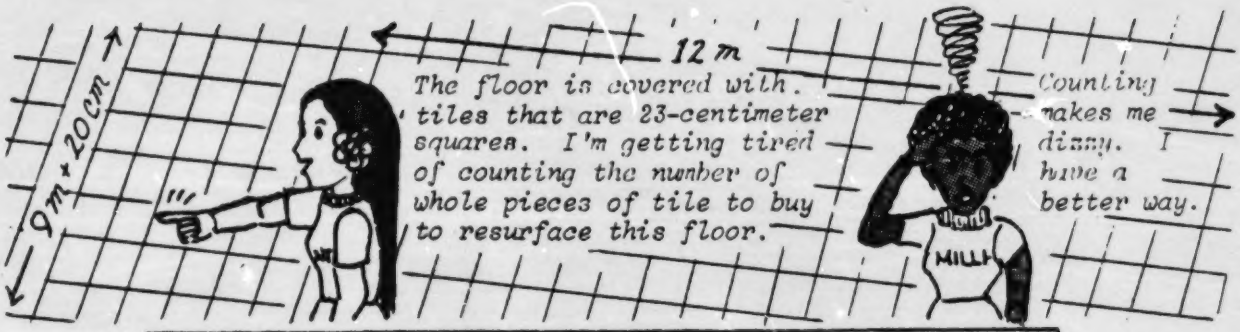
f. $\begin{array}{r} 7.05 \\ \times\ 2.8 \\ \hline \end{array}$

g. $\begin{array}{r} 0.75 \\ \times\ 0.3 \\ \hline \end{array}$

h. $\begin{array}{r} 0.67 \\ \times\ 9.9 \\ \hline \end{array}$

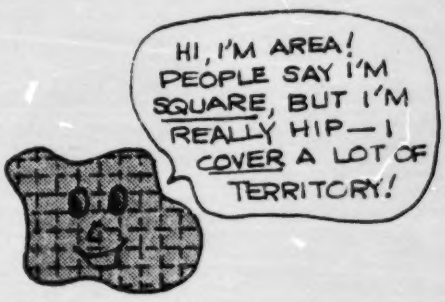
i. $\begin{array}{r} 13.78 \\ \times\ \ .04 \\ \hline \end{array}$

j. $\begin{array}{r} 1.8 \\ \times\ 0.7 \\ \hline \end{array}$


12 m
9 m + 20 cm
The floor is covered with tiles that are 23-centimeter squares. I'm getting tired of counting the number of whole pieces of tile to buy to resurface this floor.
Counting makes me dizzy. I have a better way.
MILLI

# AREA

Area is the measure of the surface of a region. A square region is chosen as the unit of measurement. The area of any region is measured by counting the number of squares needed to completely cover the region.




To get an idea of area, we will use the square decimeter to find areas of regions around the classroom.

Making a Square Decimeter

a. Use construction paper (or thick paper) to cut out a square decimeter (a square whose sides are 10 *cm* each). Be sure to measure accurately!

b. Check to see that your square decimeter fits perfectly onto the one shown.

c. We use the symbol $dm^2$ for square decimeter. Use a colored pen to label your square decimeter as shown.

d. Now use your square decimeter to find the areas of each object below to the closest square decimeter.

1 $dm^2$

1) The cover of this book _____

2) The top of your desk _____

3) The seat of your chair _____

4) The front blackboard _____

In the metric system, frequently used units to measure area are:

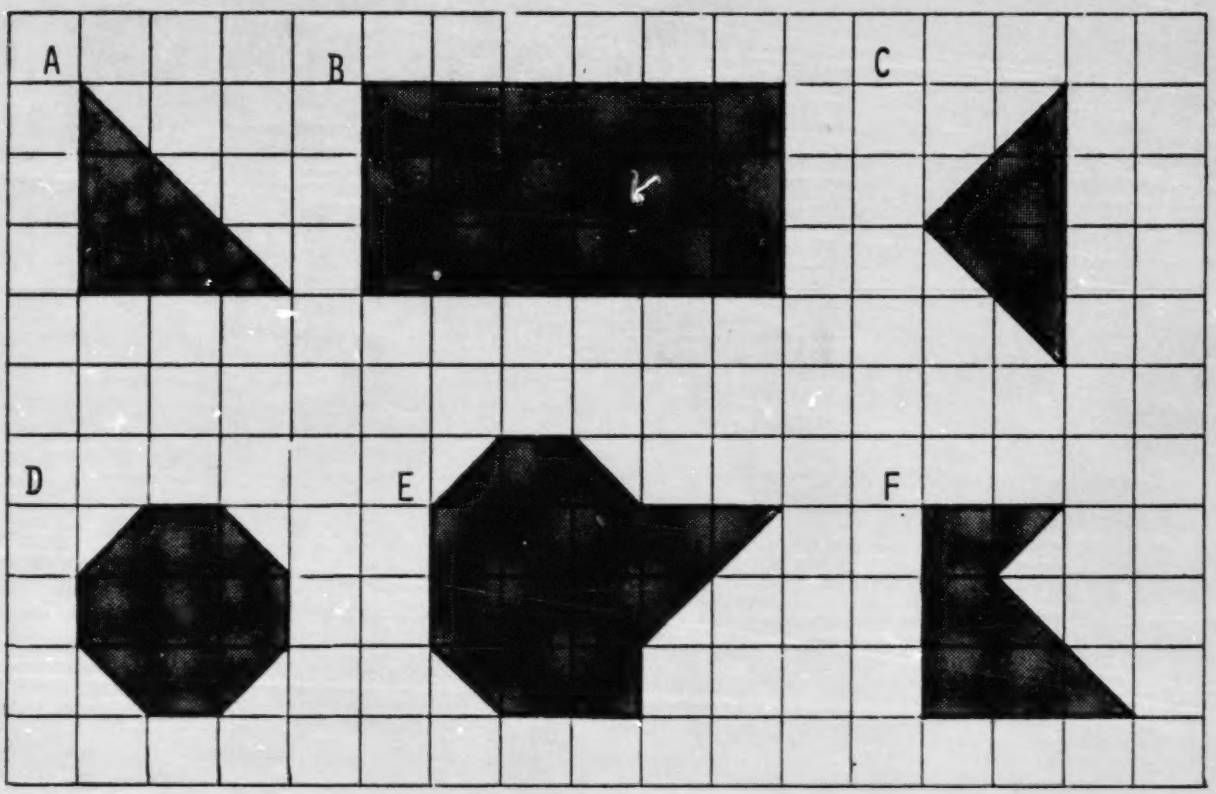
Square centimeters ($cm^2$) for small areas such as the area of a page in a book.

Square meters ($m^2$) for larger areas such as the area of the floor of a classroom.

Square kilometers ($km^2$) for very large areas such as the area of the island of Molokai.

The square centimeter will be used to measure area for the exercises in this booklet. This is a square centimeter:

1.




Find the area of the above figures and record your answers in the appropriate blanks below.

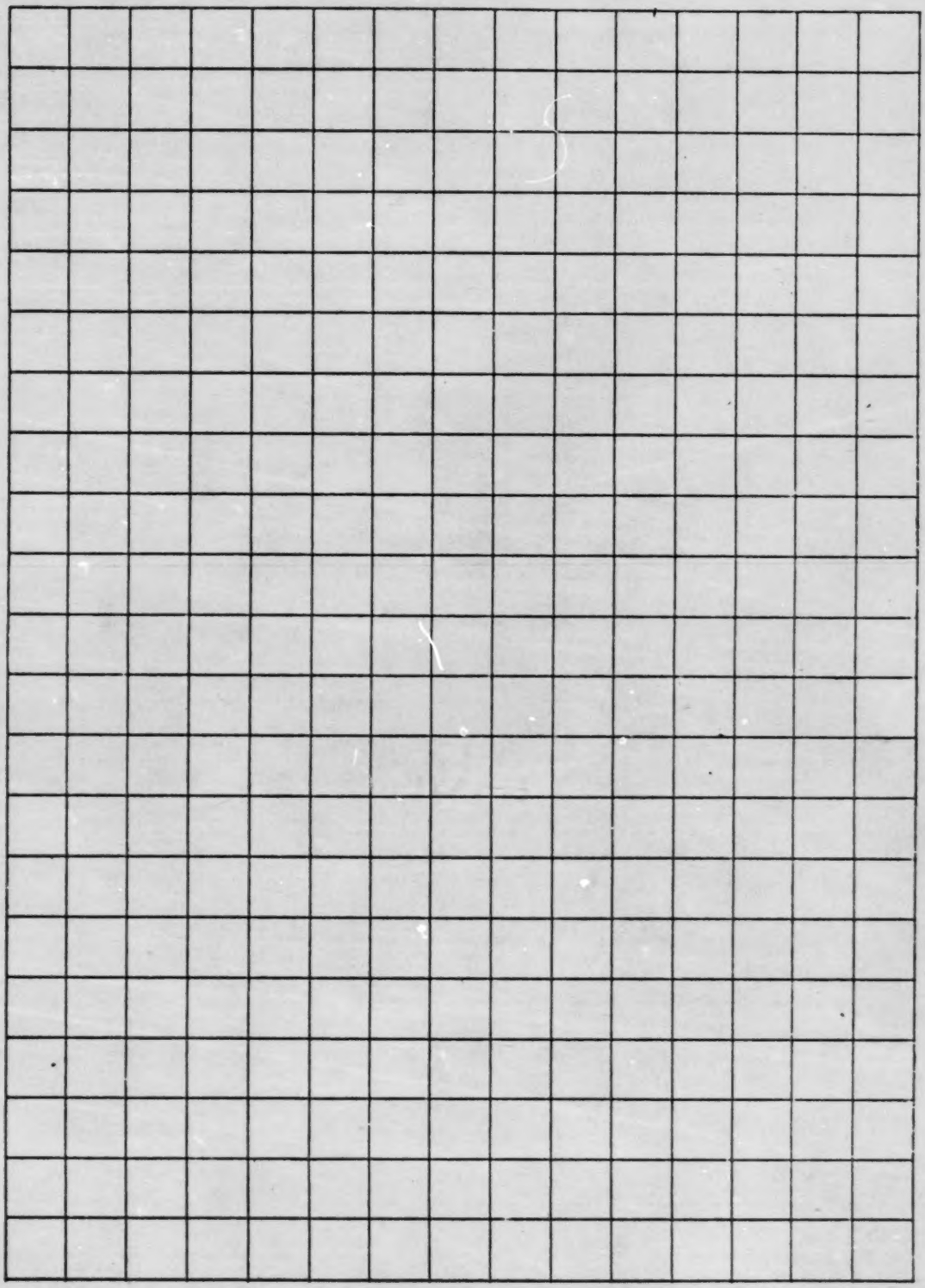
A _____ $cm^2$ D _____

B _____ $cm^2$ E _____

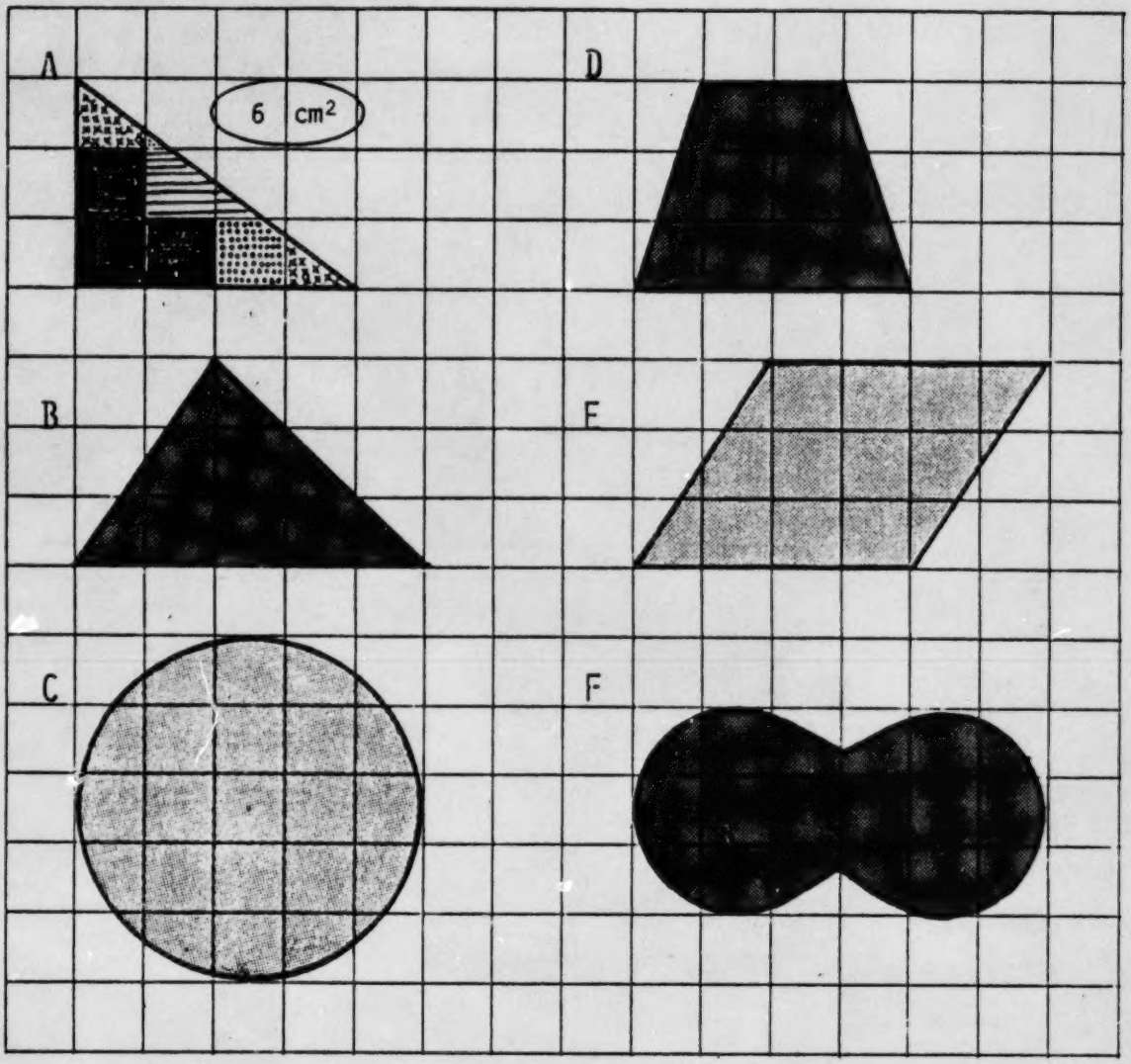
C _____ $cm^2$ F _____

2. Use the square centimeter graph paper below and draw three different polygons which have the area of:

a. 15 $cm^2$ b. 20 $cm^2$



3. Count the approximate number of square centimeters within each figure and find the area to the nearest square centimeter. The first one has been done for you.

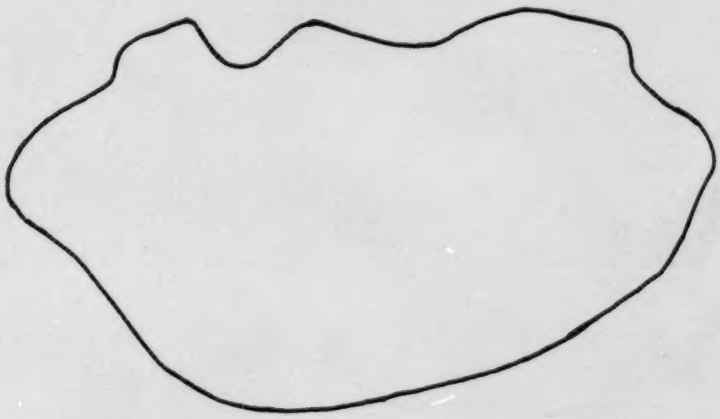



4. Write $cm^2$, $m^2$, or $km^2$ as the most appropriate unit to use to measure the area of each surface.

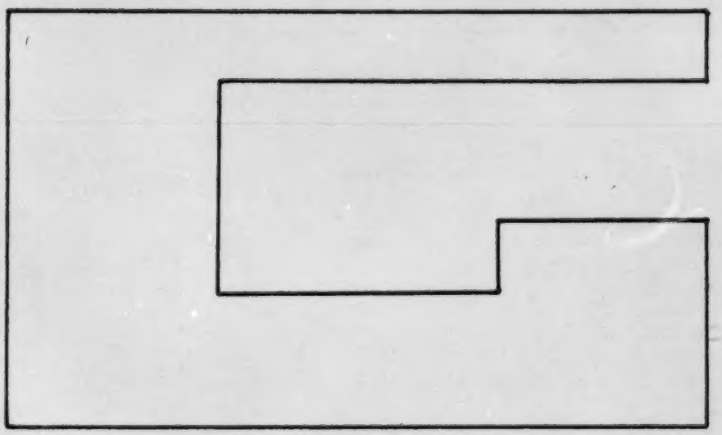
a. Page in a book _____
b. The State of Hawaii _____
c. Seat of wheel chair _____
d. Foot rest of wheel chair _____
e. Bottom of rubber tip on a crutch _____
f. The sidewalk in front of your school _____
g. A TV screen _____
h. Picture in a wallet _____
i. The face of a quarter _____
j. The grassy part of your school yard _____
k. Waikiki beach _____
l. The amount of material to make a ping pong ball _____

5. Estimate the areas of the following regions. Then find the areas to the nearest square centimeter by marking the region into square centimeters.

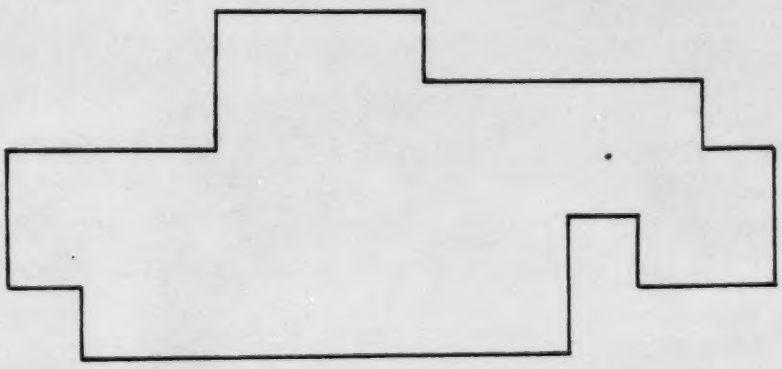
a.



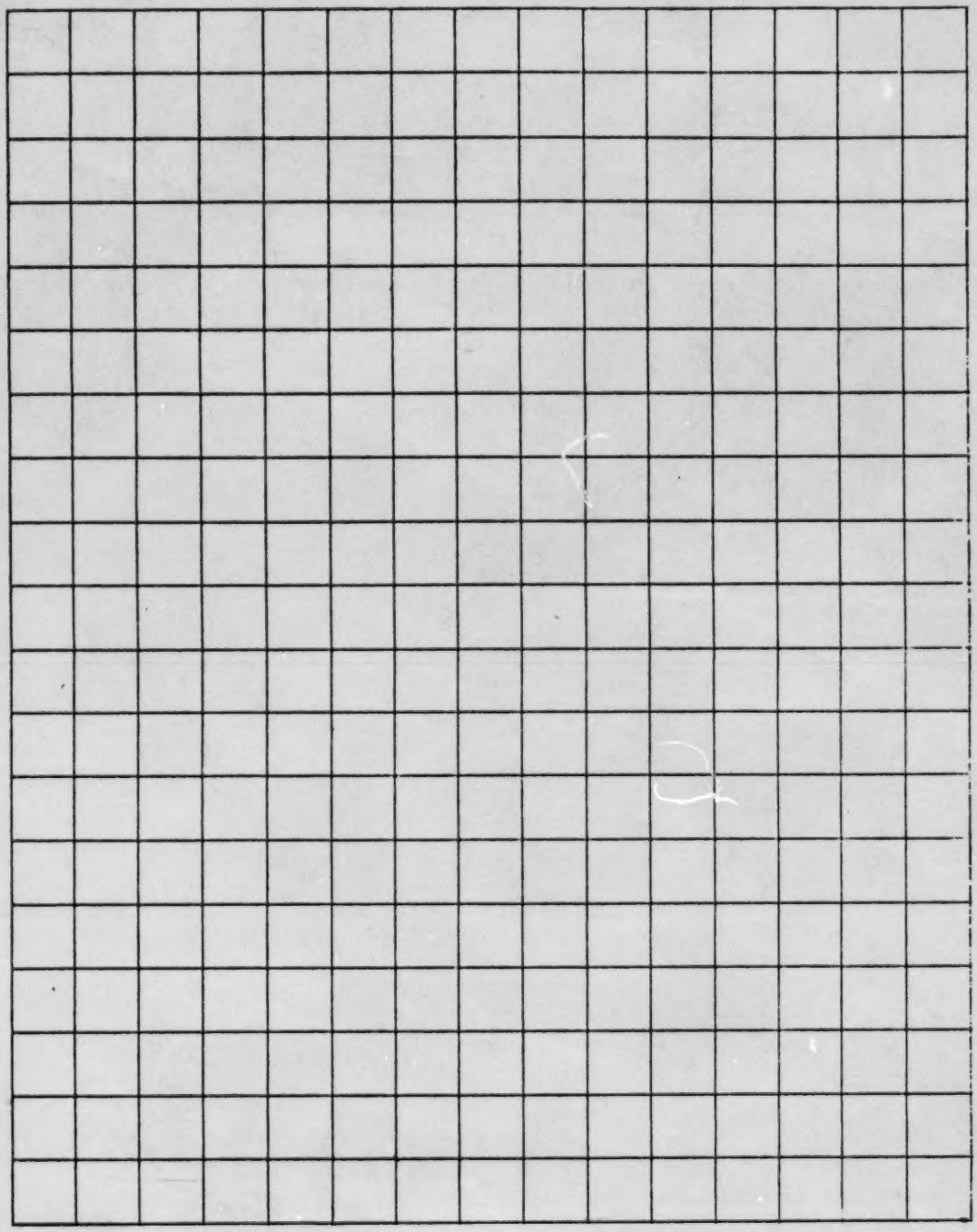
b.



c.

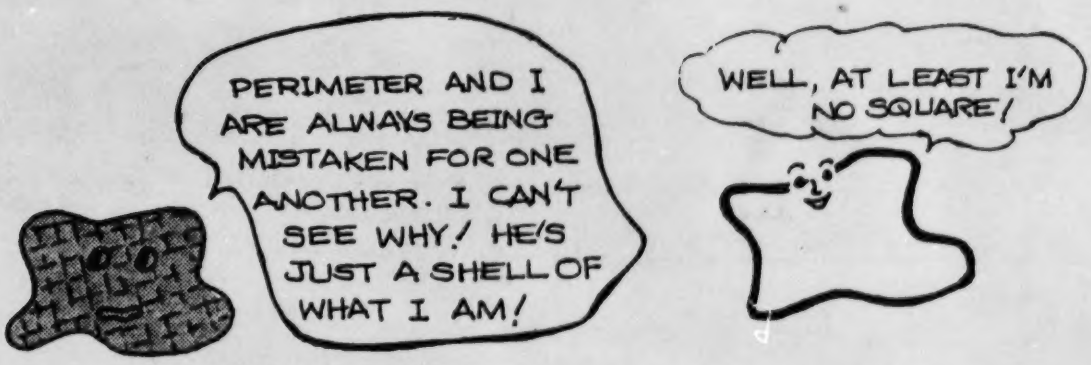


6. Outline your hand.



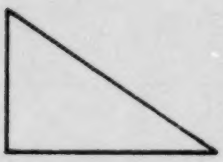
The surface area of your hand is about 1% of the surface area of your body. The surface area of your body is about _____.

7.


PERIMETER AND I ARE ALWAYS BEING MISTAKEN FOR ONE ANOTHER. I CAN'T SEE WHY! HE'S JUST A SHELL OF WHAT I AM!
WELL, AT LEAST I'M NO SQUARE!

For each of the following regions, find both the area and the perimeter. Express area answers to the nearest square centimeter and perimeter answers to the nearest centimeter.

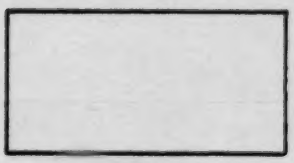
a.



A = _____

P = _____

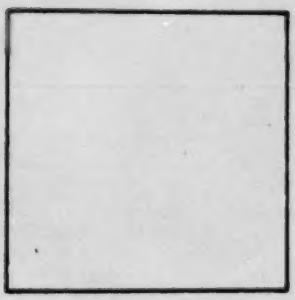
b.



A = _____

P = _____

c.



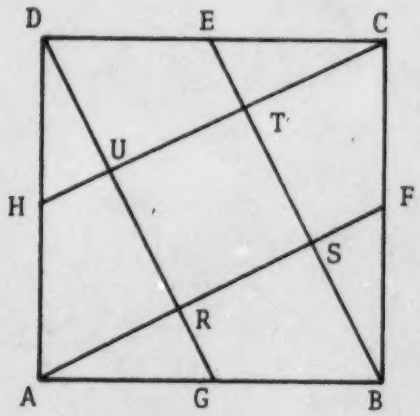
A = _____

P = _____

8. Project: There is a sign in front of your school. On it is the name of your school. Estimate. Then measure.

| | Estimate | Measurement |
|---|---|---|
| a. Length of sign | _____ | _____ |
| b. Width of sign | _____ | _____ |
| c. What is the perimeter of the sign? | _____ | _____ |
| d. What is the area of the sign? | _____ | _____ |

9. Project: ABCD is a square. Each side is 5 centimeters long. E, F, G, and H are midpoints of a side of the square. Segments are drawn as shown.




a. The area of square ABCD is _____ $cm^2$.

b. Estimate the area of square RSTU. _____ $cm^2$

c. Measure to find the area of square RSTU. _____ $cm^2$

d. The area of square RSTU is what fraction of the area of square ABCD?

_____

10. **** *How many pieces of tile are needed to resurface the rectangular floor?*

*That phone booth is about 1300 $dm^3$.*

*That's 1 300 000 $cm^3$.*

*My volume is about 60 000 $cm^3$.*

# VOLUME

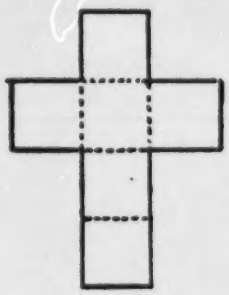
Volume is the amount of space an object takes up or the measure of the space inside a closed surface. Cubic units are used to measure volume. The commonly used units in the metric system are the cubic centimeter ($cm^3$), the cubic decimeter ($dm^3$), and the cubic meter ($m^3$).

1. Cube Making

   Materials: one 3 x 5 index card, one sheet of large construction paper, pencil, scissors, ruler, scotch tape

   Procedure:

   a. On the index card, make a pattern for a cube with faces measuring 1 cm x 1 cm. See diagram.

   b. On the sheet of construction paper, make a pattern for a cube with faces measuring 1 dm x 1 dm.

   c. Cut out the patterns along the solid line. Fold along the dotted lines. Tape in place to form cube. Save for later use.

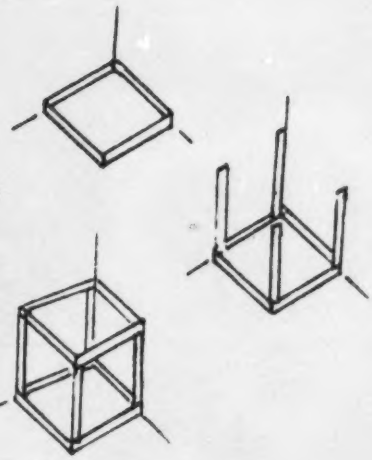
   d. The smaller cube is called a cubic centimeter ($cm^3$). The larger cube is called a cubic decimeter ($dm^3$).

2.


   Make a Cubic Meter!

   Materials needed: 12 meter sticks, a roll of masking tape, 3 able volunteers

Procedure:



a. Use four meter sticks to make a square meter in one corner of the floor of your classroom. Use masking tape to fasten the sticks together.

b. Make another square meter out of four more sticks. Save for step d.

c. Place each of the remaining meter sticks upright at the four corners of your square meter.

d. Tape the second square meter to the top of the four upright sticks.

e. Reinforce with masking tape.

f. The space within the twelve meter sticks is one cubic meter.

3. Volume of small objects is measured by cubic centimeters. Volume of very large objects is measured by cubic meters. For each object named below write $cm^3$ or $m^3$ as the most appropriate unit for finding the volume.

a. cereal carton _____ d. peanut butter jar _____

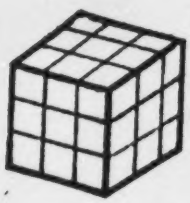
b. swimming pool _____ e. flower pot _____

c. classroom _____ f. washing machine _____

4. Materials needed: about 40 cubic centimeters

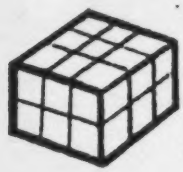
For each problem, stack your cubic centimeters to make the shape shown. To find volume, count the cubes used to make the shape.

a.



Volume: _____ cubes

b.

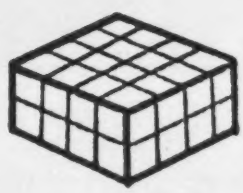


Volume: _____ cubes

c.

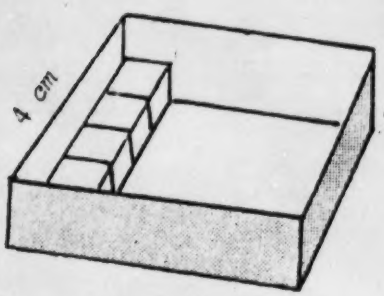
Volume: _____ cubes

d.



Volume: _____ cubes

5. Use your cubic centimeters to find the volume of Box A.




a. Fit a row of cubic centimeters along the 4 *cm* side.

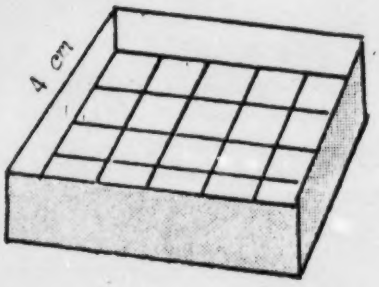
_____ cubic centimeters fit along this row.

b. Fill the bottom of the box with the cubic centimeters.

_____ rows of cubic centimeters are needed.

_____ cubic centimeters fill the bottom layer.

c. Fill the box with cubic centimeters.




_____ layers of cubic centimeters are needed to fill the box.

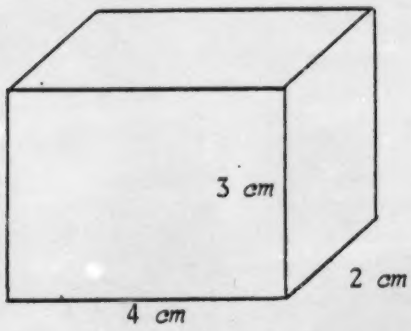
d. The volume of Box A is _____ cubic centimeters.

The volume of Box A is _____ x _____ x _____ =

_____ $cm^3$.

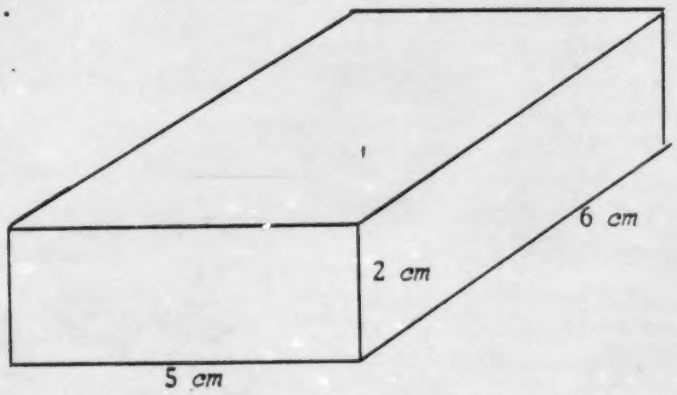
6. Find the volume of each box pictured below.

a.



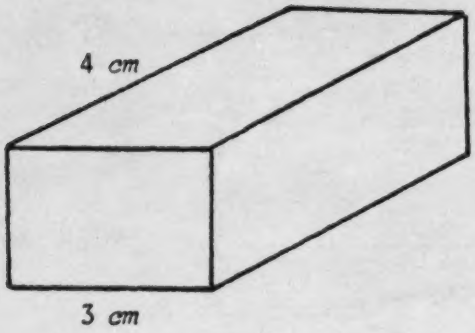

Volume: _____ $cm^3$

b.



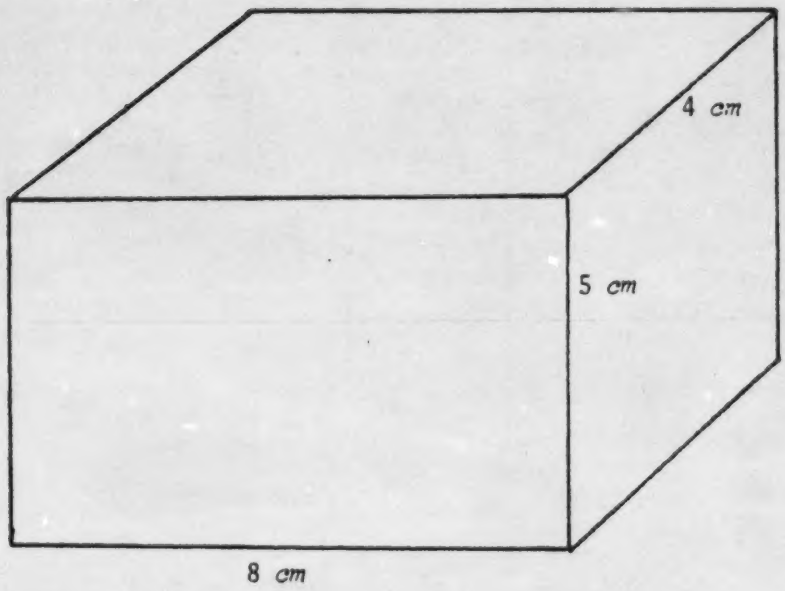

Volume: _____ $cm^3$

c.



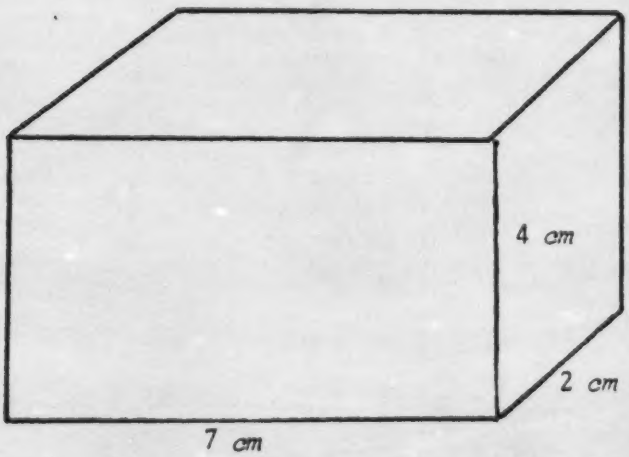

Volume: _____ $cm^3$

d.



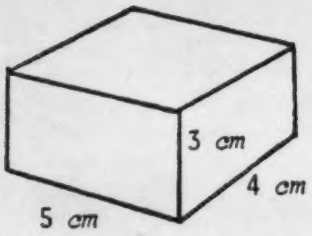

Volume: _____ $cm^3$

e.



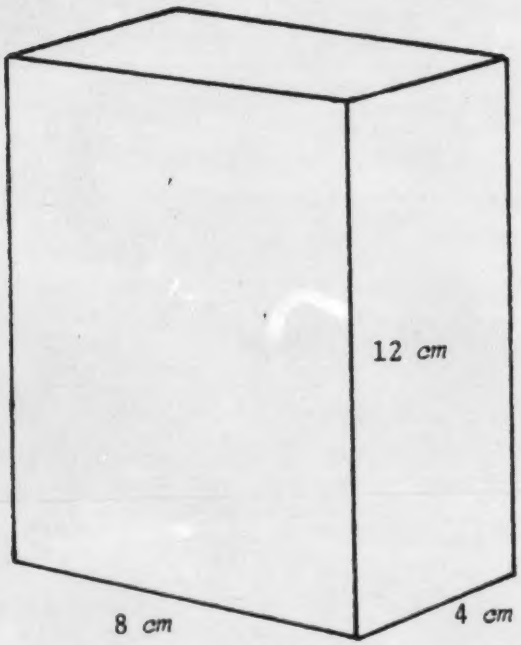

Volume: _____ $cm^3$

f.



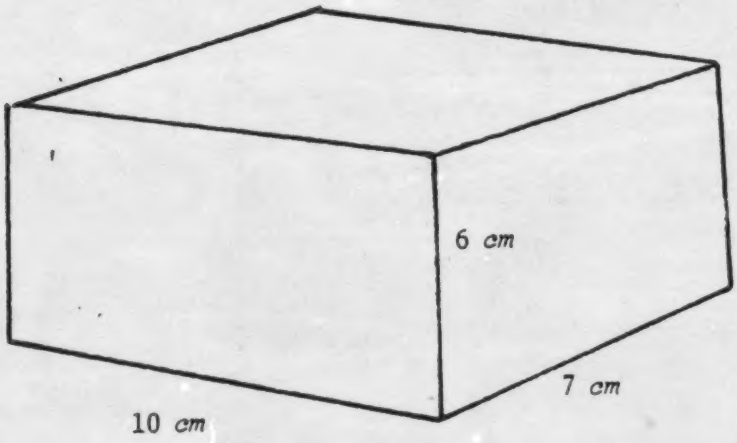

Volume: _____ $cm^3$

g.



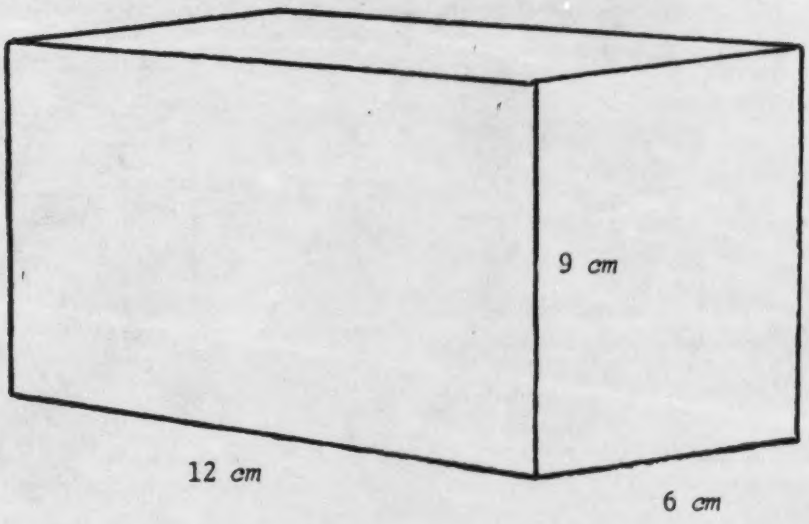

Volume: _____ $cm^3$

h.



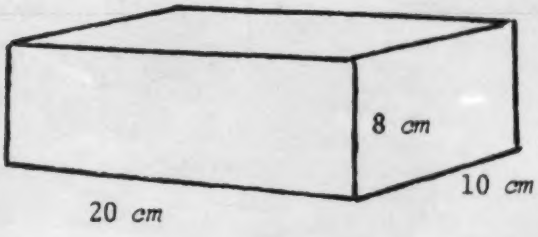

Volume: _____ $cm^3$

i.




Volume: _____ $cm^3$

j.



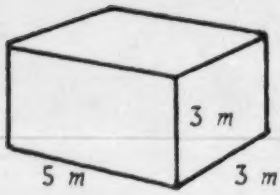

Volume: _____ $cm^3$

7. Estimate the volumes of the following to the nearest cubic centimeter. Then find the volumes by measuring.

| | Estimate | Measurement |
|---|---|---|
| a. a matchbox | _____ | _____ |
| b. a shoebox | _____ | _____ |
| c. a box of staples | _____ | _____ |
| d. a box of paper clips | _____ | _____ |

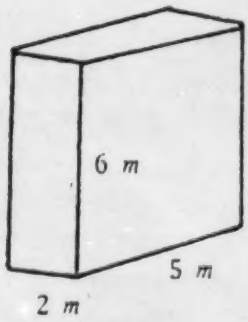
8. Find the volume of each box pictured below. Notice that the meter ($m$) is the linear unit. So the unit of volume is the cubic meter ($m^3$).

a.



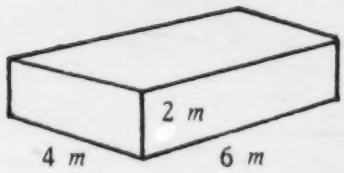

Volume: _____ $m^3$

b.



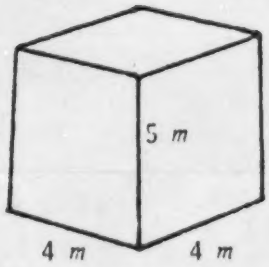

Volume: _____ $m^3$

c.



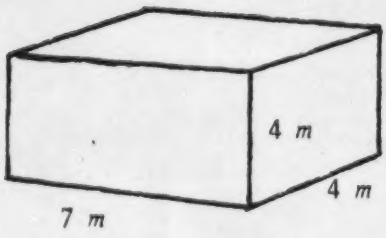

Volume: _____ $m^3$

d.



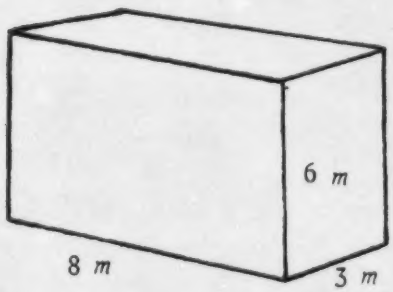

Volume: _____ $m^3$

e.




Volume: _____ $m^3$

f.



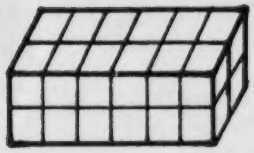

Volume: _____ $m^3$

9. a. How many cubic centimeters in one cubic decimeter? _____

b. How many cubic decimeters in one cubic meter? _____

**c. How many cubic centimeters in one cubic meter? _____

10. Project: Use 24 cubic centimeters. How many boxes of different shapes can you make? One example is 2 *cm* by 2 *cm* by 6 *cm*. Write the dimensions of all boxes.



11. Project: You have a supply of many cubic decimeters. How many are needed to fill your classroom? Write a plan of what you would do to find the answer.

12. Project: A supermarket has many different-sized paper bags. Estimate the volume of each opened bag in cubic centimeters.

| | | Estimate | | | Estimate |
|---|---|---|---|---|---|
| a. | Bag I | _____ $cm^3$ | c. | Bag III | _____ $cm^3$ |
| b. | Bag II | _____ $cm^3$ | d. | Bag IV | _____ $cm^3$ |

e. Describe a way to find the volume of an opened paper bag by measuring.

13. **** *How many people can the phone booth hold?*
*Does your estimate of the number of people in the phone booth agree with the Guiness world record?*

*I need exactly 4 liters of ocean water. I only have a 3-liter measure and a 5-liter measure.*

*I can get exactly 4 liters of water using only those two measures.*

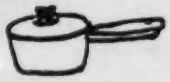
# *liter* *l* CAPACITY *milliliter* *ml*

The unit of capacity is the liter. One liter is about 1 quart.

THERMOS

MILK CARTON

PITCHER


SAUCEPAN

Each container holds about 1 liter.

Metric units commonly used to measure capacity are:

liter, milliliter, and kiloliter.

1. Fill in the blanks.

   a. Milli- means _____, so 1 milliliter = _____ liter.

   b. A milliliter is _____ (less than, more than) a liter, so the milliliter is used to measure _____ (very small, very large) containers.

   c. Kilo- means _____, so 1 kiloliter = _____ liters.

   d. A kiloliter is _____ (less than, more than) a liter, so the kiloliter is used to measure _____ (very small, very large) containers.

2. Write *ml*, *l*, or *kl* as the most appropriate unit to use to measure the capacity of each item.

   a. A bottle of shampoo _____
   b. A coffee pot _____
   c. A glass of water _____
   d. A swimming pool _____
   e. Large bottle of Coke _____
   f. Oil company gas truck _____
   g. Gasoline tank of car _____
   h. A drinking straw _____
   i. Can of guava juice _____
   j. A bathtub _____

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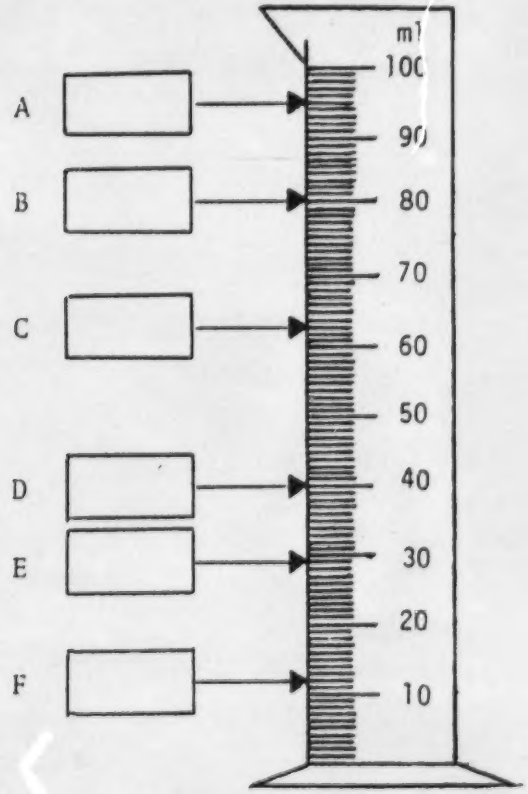
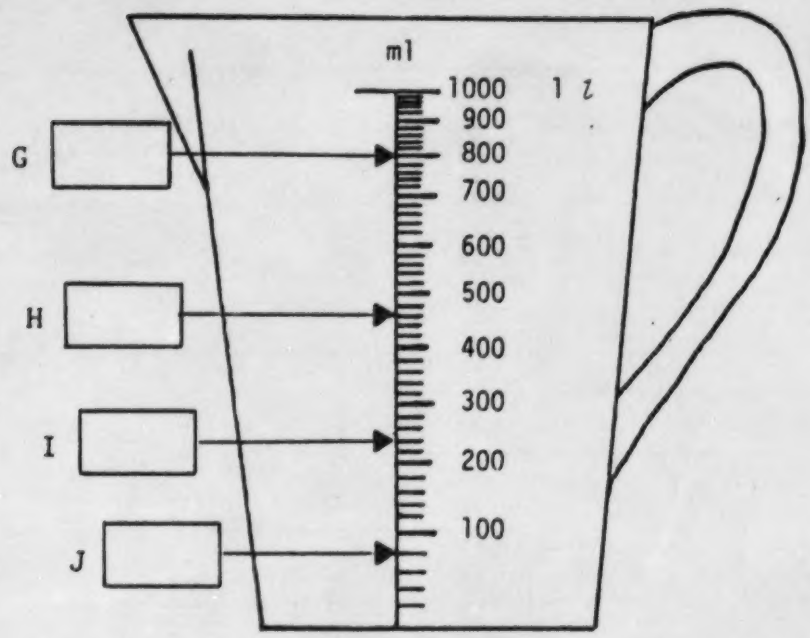
3. For each container listed below, estimate its capacity, then measure to the nearest given unit.

| OBJECT | ESTIMATE | MEASUREMENT |
|---|---|---|
| a. Soda cup | *ml* | |
| b. Juice can | *ml* | |
| c. Milk carton | *l* | |
| d. Small wastepaper basket | *l* | |
| e. Coffee cup | *ml* | |
| f. Coke can | *ml* | |
| g. Mayonnaise jar | *ml* | |

4. Write the capacity measurement in the box next to each arrow.






5. Circle the most appropriate measurement for each object.

| | | | |
|---|---|---|---|
| a. | Bottle of cola | 500 *ml* | 5 *l* | 500 *l* |
| b. | Laundry bucket | 8 *ml* | 800 *ml* | 8 *l* |
| c. | Kitchen sink | 50 *ml* | 5 *l* | 50 *l* |
| d. | Cup of coffee | 200 *ml* | 2 *l* | 200 *l* |
| e. | Cooking pot | 4 *ml* | 400 *ml* | 4 *l* |
| f. | Carton of milk | 24 *ml* | 240 *ml* | 24 *l* |
| g. | Bathtub | 400 *ml* | 4 *l* | 400 *l* |
| h. | Can of paint | 4 *ml* | 4 *l* | 40 *l* |
| i. | Eyedropper | 1 *ml* | 16 *ml* | 60 *ml* |
| j. | Can of soup | 15 *ml* | 300 *ml* | 3 *l* |

6. Fill in each blank with a metric prefix.

   a. The metric prefix which means 1000 is _____.

   b. The metric prefix which means 100 is _____.

   c. The metric prefix which means 10 is _____.

   d. The metric prefix which means 0.1 is _____.

   e. The metric prefix which means 0.01 is _____.

   f. The metric prefix which means 0.001 is _____.

7. Fill in each blank with a metric symbol.

   1000 $l$ = 1 _____ 0.1 $l$ = 1 _____

   100 $l$ = 1 _____ 0.01 $l$ = 1 _____

   10 $l$ = 1 _____ 0.001 $l$ = 1 _____

8. Fill in the blanks.

   a. 3 $kl$ = _____ $l$ b. 4 $hl$ = _____ $l$

   c. 5 $dal$ = _____ $l$ d. 20 $dl$ = _____ $l$

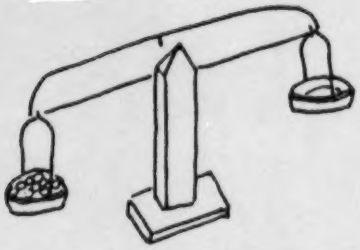
   e. 30 $cl$ = _____ $l$ f. 500 $ml$ = _____ $l$

9. Project: Write the best and quickest way to find the capacity of each of the following:

   a. The waste paper basket in your classroom.

   b. A garbage can (like the one used at your home).

10. **** *Tell how 4 liters of water can be measured using the 3-liter and 5-liter containers.*



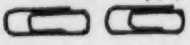
*I have 9 marbles in all. 8 marbles have the same mass, but there's one that has less mass than the others.*

*By using the balance, I can find the marble with less mass in 3 measurements.*

# *kilogram* *kg* MASS *gram* *g*

A gram is a unit of mass in the metric system. Here are the masses of some objects in the classroom.

TWO PAPER CLIPS

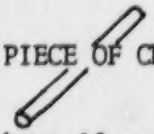


about 1 gram

A NICKEL

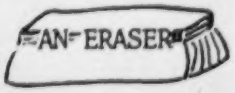
about 5 grams

A PIECE OF CHALK



about 10 grams

AN ERASER



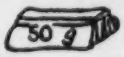
about 50 grams

For measuring larger masses, the kilogram is used. A kilogram is about two pounds. Since kilo- means one thousand, 1 kilogram = _____ grams.

For very small masses, milligrams are used. Since milli- means one thousand*th*, 1 milligram = _____ grams

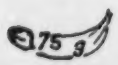
1 gram = _____ milligrams

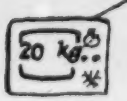
1. Draw a line from the left column to the equivalent measurement in the right column. The first problem has been done for you.

a. 


b.


c.


d. 


e. 


f.


- 20000 *g*
- 0.175 *kg*
- 0.050 *kg*
- 0.450 *kg*
- 500 *g*
- 1000 *g*

2. For each item below, estimate its weight using the specified unit, then measure and complete the chart.

| OBJECT | ESTIMATE | MEASUREMENT |
|---|---|---|
| a. empty bottle | _____ *g* | _____ |
| b. ballpoint pen | _____ *g* | _____ |
| c. nickel | _____ *g* | _____ |
| d. chalkboard eraser | _____ *g* | _____ |
| e. your teacher | _____ *kg* | _____ |
| f. three textbooks | _____ *kg* | _____ |

3. Complete by writing *kg*, *g*, or *mg*.

a. A bowling ball weighs 6 _____.
b. A loaf of bread weighs 450 _____.
c. A rowboat weighs 100 _____.
d. A football player weighs 100 _____.
e. A leaf weighs 3 _____.
f. A piece of chalk weighs 10 _____.
g. An aspirin weighs 5 _____.

4. Write *g* or *kg* as the most appropriate unit to use to measure the mass of each object.

a. pencil _____
b. teenager _____
c. surfboard _____
d. math book _____

5. Select five objects whose mass will be measured. Estimate the approximate mass of each object by lifting it. Complete the chart below. Remember to write the symbol for the unit of measurement. Use a scale to verify.

| OBJECT | ESTIMATE | MEASUREMENT |
|---|---|---|
| a. | | |
| b. | | |
| c. | | |
| d. | | |
| e. | | |

6. Add the following:

a. $\begin{array}{r} 20.3 \\ +15.8 \\ \hline \end{array}$

b. $\begin{array}{r} 14 \\ +\ 2.13 \\ \hline \end{array}$

c. $\begin{array}{r} 0.219 \\ +7.3 \\ \hline \end{array}$

d. $\begin{array}{r} 1.23 \\ 12.34 \\ +123.4 \\ \hline \end{array}$

e. $\begin{array}{r} 7.005 \\ 22.1 \\ +\ 2.58 \\ \hline \end{array}$

f. $\begin{array}{r} 61.8 \\ 7.72 \\ +\ 1.003 \\ \hline \end{array}$

7. Subtract the following:

a. $\begin{array}{r} 27.3 \\ -15.2 \\ \hline \end{array}$

b. $\begin{array}{r} 18.45 \\ -10.83 \\ \hline \end{array}$

c. $\begin{array}{r} 20.1 \\ -16.2 \\ \hline \end{array}$

d. $\begin{array}{r} 36.4 \\ -15.03 \\ \hline \end{array}$

e. $\begin{array}{r} 5.002 \\ -1.98 \\ \hline \end{array}$

f. $\begin{array}{r} 26.09 \\ -14.896 \\ \hline \end{array}$

8. Estimate the weight of each of the following. Then weigh it. Find the error.

| | ESTIMATE | MEASUREMENT | ERROR |
|---|---|---|---|
| a. One crutch | | | |
| b. A chair in the classroom | | | |
| c. A cafeteria tray | | | |
| d. Six meter rulers | | | |
| e. A liter of water | | | |
| f. A wastepaper basket | | | |

g. For which object was your error the greatest? _____
Try to write a possible reason for the greatest error for the object.

_____

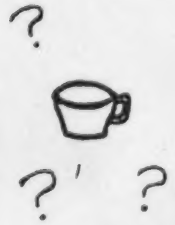
9. **** *Show how to find the marble with less mass using three measurements.*
**** *Can you find the marble with less mass using two measurements? Show how.*

| | | | | | | |
|---|---|---|---|---|---|---|
| kiloliter<br>kilogram | hectoliter<br>hectogram | dekaliter<br>dekagram | liter<br>gram | deciliter<br>decigram | centiliter<br>centigram | milliliter<br>milligram |

# $\frac{l}{ml}$ CAPACITY AND MASS $\frac{kg}{g}$

1. Write the names and symbols of the metric capacity units used in this class. Write other names and symbols of metric capacity units that you can think of.

| NAME | SYMBOL |
|---|---|
| | |



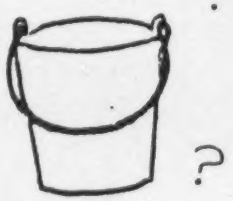
2. Circle the greater capacity.

   a. 20 *ml* or 2 *l*

   b. 1500 *ml* or 1 *l*

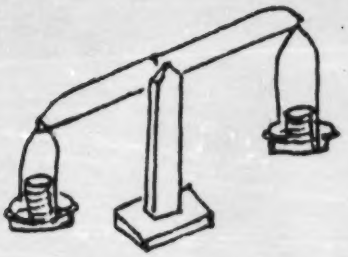
   c. 2500 *ml* or 12 *l*

   d. 289 *ml* or 3 *l*




3. Write the name and symbol of metric mass units used in this class. Write other names and symbols of metric mass units that you can think of.

| NAME | SYMBOL |
|---|---|
| | |



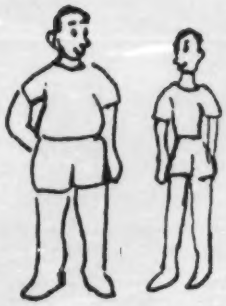
4. Circle the heavier weight.

   a. 2 *kg* or 20 *g*

   b. 500 *g* or 5 *kg*

   c. 3000 *g* or 2 *kg*

   d. 450 *g* or 1 *kg*



5. For each specified measurement, circle one of the three given objects as the most appropriate container or mass.

| | | | | |
|---|---|---|---|---|
| a. | 5 *g* | pencil | small pizza | telephone speaker |
| b. | 2 *l* | glass of milk | 1/2-gallon milk carton | bucket filled with water |
| c. | 1 *g* | 2 paper clips | 2 pieces of chalk | 2 books |
| d. | 7 *kg* | sewing needle | can of beans | bowling ball |
| e. | 5 *ml* | eye dropper | teaspoon | cooking pot |
| f. | 60 *kg* | child's weight | adult's weight | lion's weight |

6. Write 'yes' if the statement is sensible. Write 'no' if the statement is not sensible. If the item is available, verify your answer by measuring.

   a. A class ring weighs 5 *kg*. _____

   b. An apple weighs 100 *g*. _____

   c. A bean weighs more than 80 *g*. _____

   d. Your weight is between 25 *kg* and 100 *kg*. _____

   e. A piece of apple pie weighs about 2 *kg*. _____

   f. A pair of scissors weighs more than 50 *g*. _____

   g. A can of soda holds about 500 *ml*. _____

   h. An aquarium holds 400 *l*. _____

   i. A tablespoon holds 15 *ml*. _____

7. For each problem, select the objects that have the approximate measurements:

| a. between 1 *kg* and 5 *kg* | b. less than 1 *l* |
|---|---|
| Bunch of carrots | Cup of orange soda |
| Telephone book | Oil drum |
| Newborn baby | Bottle of catsup |
| Pound of hamburger | Radiator of a car |

8. Take a field trip to the supermarket.

a. Review the symbols of metric units.

| Fill in the name of the metric unit. | Cross out all incorrect symbols. (HINT: There is only one correct symbol in each row.) | | | | | |
|---|---|---|---|---|---|---|
| | KG | kG | kg. | kg | Kg. | Kg |
| | mm | MM | Mn. | mM | mn. | Mm |
| | CM. | Cm | cM | cm | cm. | CM |
| | grs. | g | gm | grm | gr | gms. |
| | M | M. | m | met. | metr. | mt |
| | Li | L. | l | l. | li. | l. |
| | ML | mLi | ml | mli. | mL. | Ml |
| | MGS | mgs | mgm | MG | mgr. | mg |
| | km | KM. | km. | kM | Km | KM |

b. Find items in the store which use incorrect metric symbols on the label.

| ITEM | INCORRECT METRIC SYMBOL |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

c. List items that have metric weights on their labels.

| ITEM | WEIGHT |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

d. List items that have metric capacity units on their labels.

| ITEM | METRIC CAPACITY UNIT |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

e. List items that are sold by customary units only.

_____ _____

_____ _____

9. Subtract the following:

a. $\begin{array}{r} 6.71 \\ -2.3 \\ \hline \end{array}$ b. $\begin{array}{r} 4.006 \\ -3.02 \\ \hline \end{array}$ c. $\begin{array}{r} 15.1 \\ -\ .05 \\ \hline \end{array}$ d. $\begin{array}{r} 39 \\ -23.5 \\ \hline \end{array}$

We have been using the word weight to mean mass because on earth, for all practical purposes, weight and mass are the same.

On earth, the pull of gravity is less on high mountains.

Astronauts felt lighter on the moon because the gravitational pull on the moon is less than it is on Earth....

...but their mass remained the same on the moon as it was on Earth.

Let's see what a 100-gram mass would appear to weigh on different planets.

Complete the table:

10.

| | EARTH | MOON | JUPITER | MARS | URANUS | NEPTUNE |
|---|---|---|---|---|---|---|
| Pull of Gravity | x 1 | x 0.167 | x 2.6 | x 0.4 | x 0.9 | x 1.2 |
| Apparent Weight | 100 g | 16.7 g | 260 g | | | |

11. Use the table on page 55 to help you with the following chart. Round your answers off to the nearest gram or kilogram. Use the space below this chart to show your computations.

| | EARTH | MOON | JUPITER | MARS | URANUS | NEPTUNE |
|---|---|---|---|---|---|---|
| Astronaut | 72 *kg* | | | | | |
| 4 books | 600 *g* | | | | | |
| Jeep | 1400 *kg* | | | | | |
| TV set | 40 *kg* | | | | | |
| Refrigerator | 220 *kg* | | | | | |
| Dog | 25 *kg* | | | | | |
| You | | | | | | |

12. **** *Do the measurements make sense? Which items do not have sensible measurements? Explain.*

# TEMPERATURE

In the metric system the unit used to measure temperature for practical purposes, is Degree Celsius.

1. Circle the temperature that is the best approximation for the following situations.

   a. Slight fever because of a cold

      9° C  38° C  99° C

   b. A very hot day in the desert

      32° C  50° C  10° C

   c. A good day for sweaters

      60° C  35° C  15° C

   d. Hot coffee just right for drinking

      10° C  60° C  100° C

   e. Melting point of iron

      150° C  100° C  1535° C

   f. Good temperature to go swimming

      80° C  60° C  40° C

   g. Temperature of an ice cube

      0° C  -45° C  15° C

   h. Temperature used to warm rolls in the oven

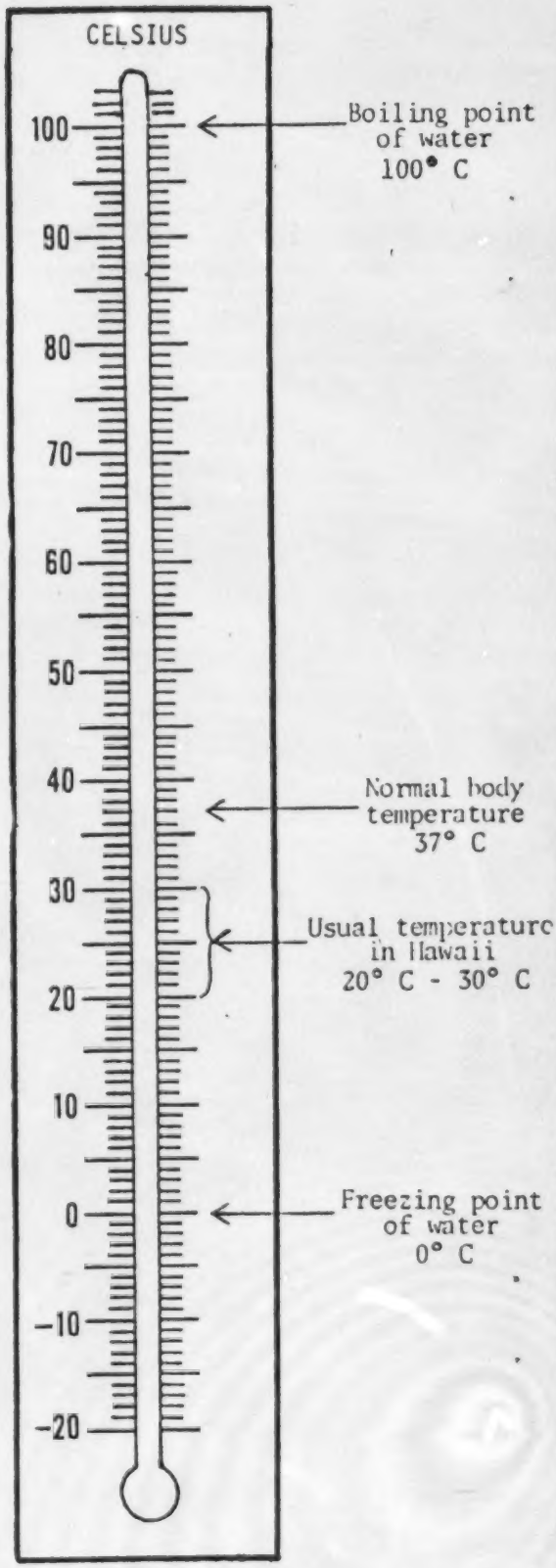
      70° C  125° C  200° C

   i. A summer day on Maui

      15° C  28° C  80° C

   j. A snow storm in Washington

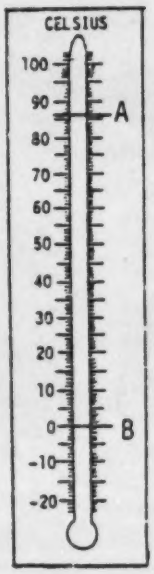
      -20° C  0° C  30° C



2. What temperatures are shown on each thermometer?

a. A _____

B _____

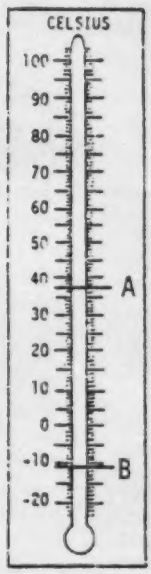



b. A _____

B _____

c. A _____

B _____




d. A _____

B _____

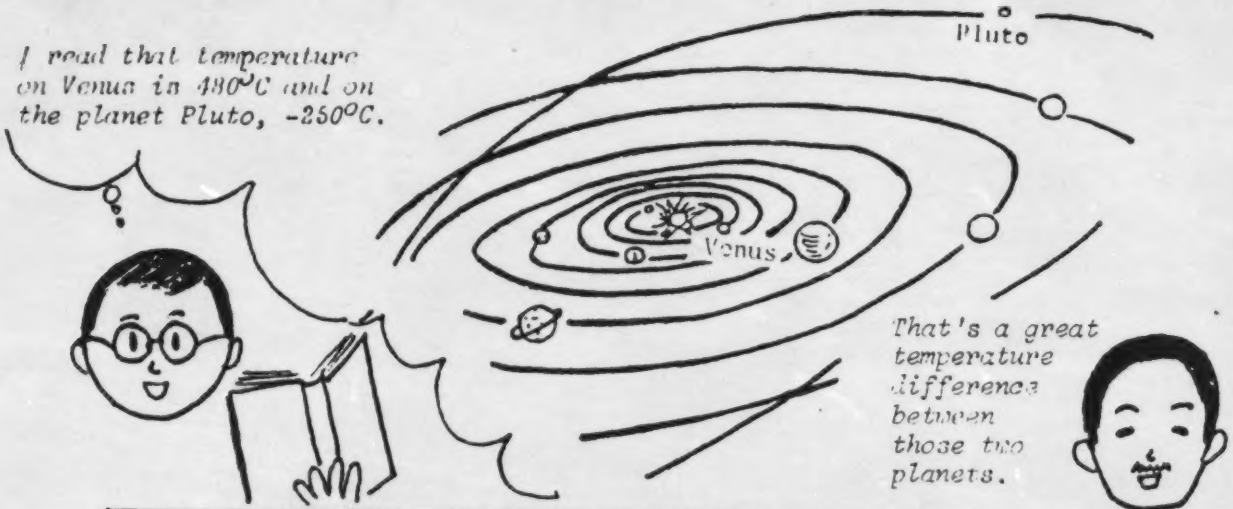
3. Shade each of the pictures to show the temperature written below each thermometer. The first one is done for you.

a. 35° C

b. 86 ° C

c. -9° C

d. 73° C


I read that temperature on Venus is 480°C and on the planet Pluto, -250°C.
Pluto
Venus
That's a great temperature difference between those two planets.

# TEMPERATURE

1. Estimate the temperature of each item. Then measure. (Give the thermometer a couple of minutes to find the right temperature.)

| ITEM | ESTIMATE | MEASUREMENT |
|---|---|---|
| a. Inside your fist | | |
| b. A glass of tap water | | |
| c. Dish of ice cubes | | |
| d. Classroom temperature | | |
| e. Outdoor temperature in sunlight | | |
| f. Outdoor temperature in shade | | |

2. Select from the list below those situations which have the following temperatures. The first problem is done for you.

Normal body temperature
Temperature for baking a cake
Room temperature
Snow storm in the midwest
Usual temperature in Hawaii
Outdoor campfire
Temperature in freezer compartment
Warm bathwater

a. between 20°C and 28°C

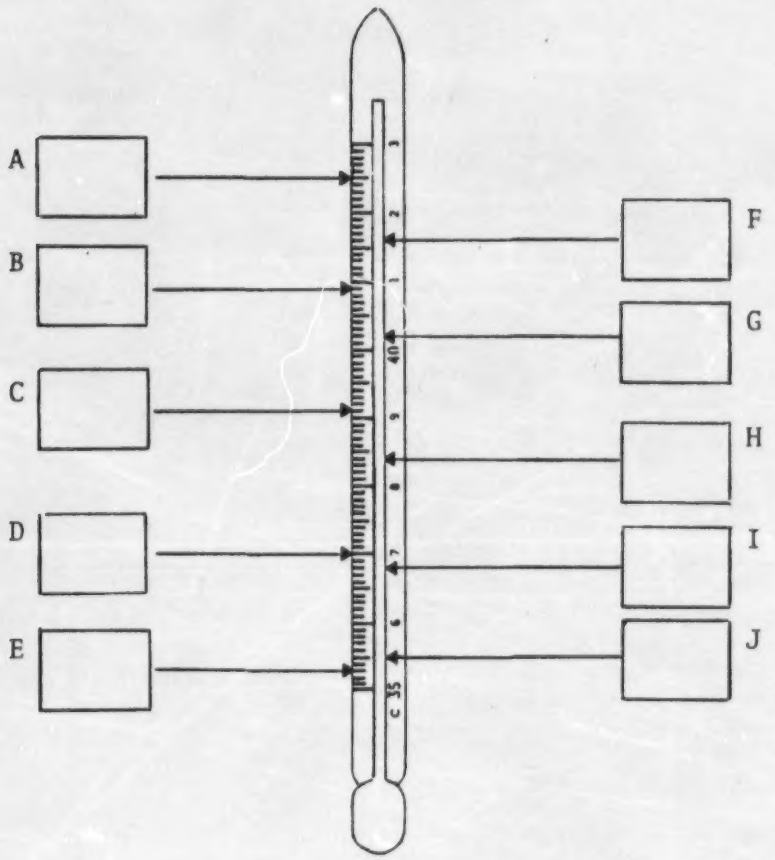
Room temperature
Usual temperature in Hawaii

b. between -40°C and 0°C

c. between 32°C and 38°C

d. between 100°C and 190°C

3. Write the temperature readings of the Celcius clinical thermometer in the boxes next to each arrow.




4. Project. List metric units and their uses appropriate to each of the following persons, places, or events.

   a. Your doctor _____

   b. A pharmacist _____

   c. A person who teaches a cooking class _____

   _____

   d. A store that sells supplies for the home (carpets, lumber, drapes, paint, etc.) _____

   _____

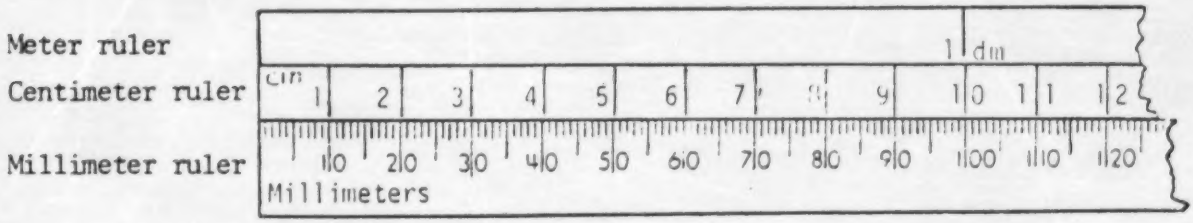
   e. The Olympic Games _____

   f. A fishing contest _____

5. **** *What is the difference in temperature between Venus and Pluto?*

# CONVERTING METRIC UNITS OF LENGTH

Lay your rulers side by side as shown. Then complete the following:




1. 4 *cm* = _____ *mm*
2. 4.5 *cm* = _____ *mm*
3. 15 *mm* = _____ *cm*
4. 23 *cm* = _____ *mm*
5. 105 *mm* = _____ *cm*
6. 1 *dm* = _____ *mm*
7. 200 *mm* = _____ *dm*
8. 25 *cm* = _____ *dm*

Now we come to some harder questions:

9. How many centimeters make one decimeter? _____ So what part of a decimeter is a centimeter? _____
10. How many millimeters make one centimeter? _____ So what part of a centimeter is a millimeter? _____
11. How many millimeters make one decimeter? _____ So what part of a decimeter is a millimeter? _____
12. 1.2 *cm* = _____ *dm*
13. 43 *mm* = _____ *dm*
14. 43 *cm* = _____ *dm*
15. 83 *cm* = _____ *dm*
16. 7 *mm* = _____ *dm*
17. 1.3 *dm* = _____ *cm*

Now complete the following:

18. _____ *m* = _____ *dm* = _____ *cm* = 8 *mm*
19. 0.15 *m* = _____ *dm* = _____ *cm* = _____ *mm*
20. _____ *m* = 300 *dm* = _____ *cm* = _____ *mm*
21. _____ *m* = _____ *dm* = 195 *cm* = _____ *mm*

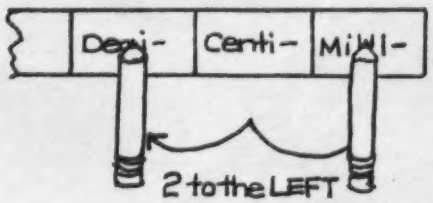
Look at your answers to problems 18-21. Do you notice a pattern?

You can use the chart below to help you convert quickly.

| Kilo- | Hecto- | Deka- | Meter | Deci- | Centi- | Milli- |
|---|---|---|---|---|---|---|

For example, to convert 8 *mm* to decimeters:

Put your pencil on "milli-" and count over to "deci-". Your pencil moved two spaces to the left, so the decimal point is moved two places to the left. Note that zeroes must be added.




Doesn't this agree with what you had in problem 18?

Try a few more examples. Then check them with your answers to problems 18 - 21.

22. Convert 0.15 *m* to centimeters. _____

23. Convert 300 *dm* to millimeters. _____

24. Convert 1950 *mm* to meters. _____

Complete the following conversions:

25. 3 *m* = _____ *cm*

26. 4.6 *m* = _____ *dm*

27. 550 *cm* = _____ *m*

28. 225 *mm* = _____ *m*

29. 20 *cm* = _____ *m*

30. 1400 *m* = _____ *km*

31. 36 *cm* = _____ *mm*

32. 0.112 *m* = _____ *dm*

33. 2.1 *hm* = _____ *m*

34. .4589 *m* = _____ *dam*

Add the measurements and write your sum for the specified units.

35. 1.3 *dm* + 4 *dm* + 0.6 *dm* = _____ *dm* = _____ *mm*

36. 25 *cm* + 0.3 *dm* + 0.04 *m* = 25 *cm* + _____ *cm* + _____ *cm* = _____ *cm* = _____ *m*

37. 3.95 *m* + 253 *cm* = _____ *mm* = _____ *m*

Subtract the measurements and write your differences for the specified units.

38. 6.7 *cm* - 1.8 *cm* = _____ *cm* = _____ *mm*

39. 1.5 *m* - 966 *mm* = _____ *mm* - 966 *mm* = _____ *mm* = _____ *m*

40. 675 *cm* - 3.7 *dm* = _____ *cm* = _____ *dm*

# CONVERTING METRIC UNITS

In the previous lesson, you learned a shortcut for converting metric units of length. The nice thing about the metric system is that similar relationships exist between units of mass, and also, units of capacity.

Thus, to convert 2 liters to centiliters, we can use the same chart:

| Kilo- | Hecto- | Deka- | Meter (*m*)<br>Liter (*l*)<br>Gram (*g*) | Deci- | Centi- | Milli- |
|---|---|---|---|---|---|---|
| | | | | | | |

CONVERT: 2 liters to centiliters

Put your pencil on liter and count over to centi-. Your pencil moved 2 spaces to the right, so the decimal point is moved 2 places to the right. Note that zeroes must be added.

$2\,l = 200\,cl$

CONVERT: 342 decigrams to hectograms

Place your pencil on deci- and count over to hecto-. Your pencil moved 3 places to the left, so the decimal point is moved 3 places to the left.

$342\,dg = .342\,hg$

Complete the following conversions.

1. 7 *l* = _____ *kl*
2. 1033 *mm* = _____ *m*
3. 2.3 *km* = _____ *hm*
4. 250 *ml* = _____ *l*
5. 475 *g* = _____ *dg*
6. 1500 *m* = _____ *km*
7. 2.8 *l* = _____ *ml*
8. 28 *kg* = _____ *g*
9. 9.14 *kg* = _____ *hg*
10. 62.5 *kl* = _____ *l*
11. 0.75 *km* = _____ *m*
12. 2.1 *dal* = _____ *cl*
13. 22 *dag* = _____ *kg*
14. 62 *l* = _____ *hl*

15. Add or subtract measurements.

a. 2.3 *g* + 45 *g* + 0.36 *g* = _____ *g*

2300 *mg* + 45000 *mg* + 360 *mg* = _____ *mg*

b. 152 *g* + 217.5 *g* + 61.21 *g* = _____ *g*

0.152 *kg* + 0.2175 *kg* + 0.06121 *kg* = _____ *kg*

c. 23.8 *m* - 3.289 *m* = _____ *m*

2380 *cm* - 328.9 *cm* = _____ *cm*

d. 217.1 *ml* - 89.23 *ml* = _____ *ml* = _____ *l*

e. 652.25 *cm* - 28.3 *cm* = _____ *cm* = _____ *dam*

16. Now try these. The first one is done for you.

a. 2 *m* and 30 *cm* =

200 *cm* and 30 *cm* = 230 *cm*

b. 3 *l* and 450 *ml* =

_____ *ml* and 450 *ml* = _____ *ml*

c. 1 *kg* and 2568 *g* =

_____ *g* and 2568 *g* = _____ *g*

d. 2 *m* and 3 *dm* and 65 *cm* =

_____ *cm* and _____ *cm* and 65 *cm* = _____ *cm*

e. 2 *hl* and 15 *l* and 456 *cl* =

_____ *cl* and _____ *cl* and 456 *cl* = _____ *cl*

17. OLYMPIC MEASUREMENTS

a. The longest distance event in freestyle swimming is the 1500 *m* race. How many kilometers is this?

b. The longest running event is a 30,000 *m* race. How many hectometers is this?

c. The world's record for the long jump was set in the 1968 Olympics. Bob Beamon of the United States jumped a distance of 8.90 *m*. How many centimeters was this?

18. Here are two famous sayings which have "gone metric."

a. "Give them 2.54 *cm* and they'll take 1610 *km*." Express both lengths as meters.

b. "28 *mg* of prevention is worth 2.2 *kg* of cure." Express both masses as grams.

19. Write a plan to find each of the following:

    a. The height of the flagpole in the schoolyard

    b. The weight of all books in the classroom

    c. The amount of cardboard in a box

    d. Who in your class lives farthest from the school

# METRIC MANIA

1. Locate and circle the following words in the maze below. The words are always found in a straight line forwards or backwards, going on a horizontal, vertical, or diagonal.

a. metric system
b. length
c. kilometer
d. meter
e. decimeter
f. centimeter
g. millimeter
h. area
i. square units
j. volume
k. cubic
l. capacity
m. hectoliter
n. liter
o. milliliter
p. mass
q. kilogram
r. gram
s. temperature
t. Celsius

M Y S T I N U E R A U Q S A R T E M
E N C U B I C R E T E M I C E D A I
T I T S U T B A T O V R C E N T I L
S V S Y S U D E C I M E A G S N A L
Y O H S H A C O M P A T P A C R N I
S L E M E T M I L L T E A N E T E L
C U T R R D A V E G H M C A P A C I
I M O E G L O N O S Q I I N C P E T
R E G T H E G T Y L E L T C E R M E
T R E I E T O S T N J L Y R U H P R
E A T L H P C A P G O I H T I T E M
M S R I B I R E A T H M A E S G R A
H E C T O L I T E R N R P S Q R T R
A D N I L N A R G T E S T N U A U G
R E T E M C E N T P M I L O G M R O
W I D C E N T I M E T E R O T H E L
O L I K R E T E M O L I K I M E T I
D E C I M A T S U I S L E C O L I K

2. Use a metric prefix to name the following:

a. Armed forces _____

b. 100-legged insect _____

c. Town on Oahu _____

d. Lucy's ex-husband _____

e. Mountain in Hawaii _____

f. Measure of electricity _____

3. Unscramble the following metric vocabulary words.

a. gmar _____

b. rdeetmcei _____

c. lmuvoe _____

d. mlktoiree _____

e. tecmir tsyems _____

f. retdemaek _____

g. lorgmaki _____

h. ritle _____

i. eomreehctt _____

j. gaelnh _____

k. eeiillmmrt _____

l. eetrm _____

m. etihwg _____

n. agiillmmr _____

4. Change the following nine measurements to *meters*.

a. 7 *dm* = _____ *m*

b. .14 *dam* = _____ *m*

c. 2100 *mm* = _____ *m*

d. .0028 *km* = _____ *m*

e. 35 *dm* = _____ *m*

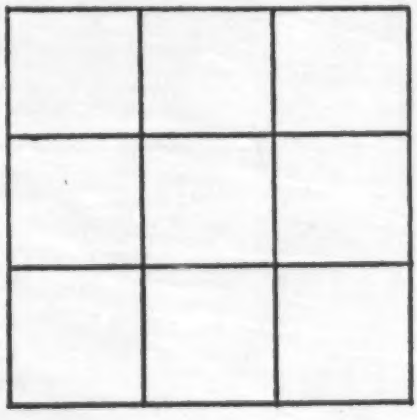
f. .042 *hm* = _____ *m*

g. 4900 *mm* = _____ *m*

h. 560 *cm* = _____ *m*

i. .0063 *km* = _____ *m*

Now place the nine lengths in terms of *meters* into the squares below. The numbers should be placed so that the sum of each row, column, and diagonal is 10.5 *m*.



*The metric system of measurement..*

*is not too difficult after all.*

*But there are a lot of new words and symbols.*

*It helps to have reference objects...*

*and their measurements to make good estimations.*

*Let's work on the problems below to review what we have learned.*

# DO YOU KNOW?

1. The six metric prefixes and their meanings (numerical values).

| | |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

2. Commonly used metric units of length and their symbols.

_____

_____

_____

_____

3. Metric unit to measure area of this page. _____

4. Metric unit to measure volume of a facial tissue box. _____

5. Your height in metric measurement. _____

6. Your weight in metric measurement. _____

7. Normal body temperature in degree Celsius. _____

8. Commonly used metric units of capacity.

_____

_____

_____

9. Commonly used metric units of mass or weight.

_____

_____

_____

10. Approximate relationship between a metric unit and a customary unit.

meter _____

centimeter _____

kilometer _____

liter _____

kilogram _____

11. Conversion from a metric measurement to another specified metric unit.

4.55 kg = _____ g

12. Name of an object, location, or situation with the following measurements:

1 meter _____

1 centimeter _____

1 kilometer _____

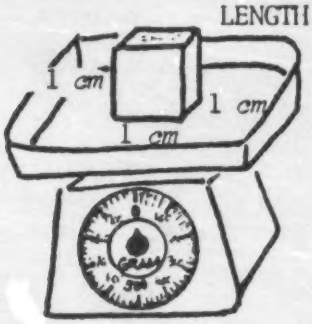
1 liter _____

1 kilogram _____

25° C _____

# RELATIONSHIPS

## LENGTH, VOLUME, AND MASS




1 cubic centimeter (1 $cm^3$)
holds
1 milliliter of water (1 $ml$)
weighs
1 gram (1 $g$)

1 cubic decimeter (1 $dm^3$)
holds
1 liter of water (1 $l$)
weighs
1 kilogram (1 $kg$)

10 $cm$ = 1 $dm$

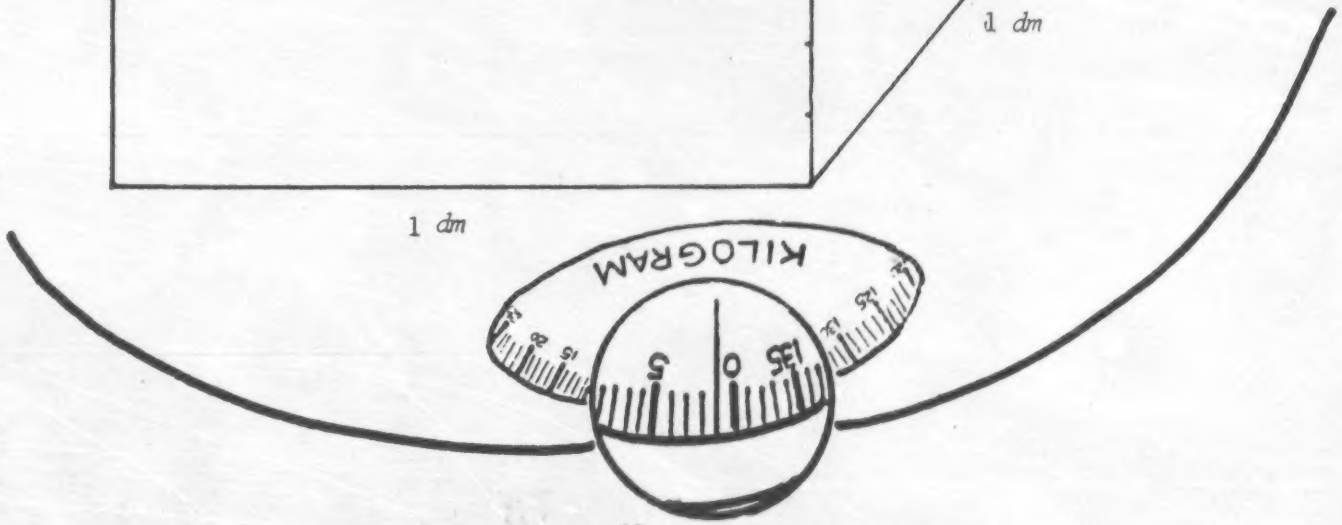
This figure represents a volume of 1000 cubic centimeters.

1000 cubic centimeters
holds
1000 milliliters

1 $dm$

1 $dm$

1 $dm$

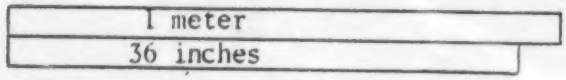


LENGTH - The unit of length is the meter.

common length relationships

1000 $m$ = 1 $km$
100 $cm$ = 1 $m$
10 $mm$ = 1 $cm$
1000 $mm$ = 1 $m$

1 $m$ = 39.36 in.




CAPACITY - The unit of capacity is the liter.

common capacity relationships

1000 $l$ = 1 $kl$
1000 $ml$ = 1 $l$
1 $cm^3$ = 1 $ml$
1 $dm^3$ = 1 $l$

1 $l$ = 1.06 qts.

MASS - The unit of mass is the kilogram.

common mass relationship

1000 $g$ = 1 $kg$

1 $kg$ = 2.2 lb.

TEMPERATURE - The unit of temperature is degree Celsius.

common temperatures

0° C - freezing point of water
22° C - room temperature
37° C - normal body temperature
100° C - boiling point of water

0°C = 32°F

*METRIC PREFIXES and THEIR MEANING*

| | | |
|---|---|---|
| exa- | 1 000 000 000 000 000 000 | $10^{18}$ |
| peta- | 1 000 000 000 000 000 | $10^{15}$ |
| tera- | 1 000 000 000 000 | $10^{12}$ |
| giga- | 1 000 000 000 | $10^{9}$ |
| mega- | 1 000 000 | $10^{6}$ |
| kilo- | 1 000 | $10^{3}$ |
| hecto- | 100 | $10^{2}$ |
| deka- | 10 | $10^{1}$ |
| deci- | 0.1 | $10^{-1}$ |
| centi- | 0.01 | $10^{-2}$ |
| milli- | 0.001 | $10^{-3}$ |
| micro- | 0.000 001 | $10^{-6}$ |
| nano- | 0.000 000 001 | $10^{-9}$ |
| pico- | 0.000 000 000 001 | $10^{-12}$ |
| femto- | 0.000 000 000 000 001 | $10^{-15}$ |
| atto- | 0.000 000 000 000 000 001 | $10^{-18}$ |

common metric prefixes

# MY METRIC MEASUREMENTS

HEIGHT _____ *cm*

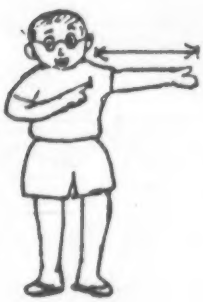
PACE _____ *cm*

HAND SPAN _____ *cm*

WEIGHT _____ *kg*

WAIST TO TOE _____ *cm*

HAT SIZE _____ *cm*



OUTSTRETCHED ARM _____ *cm*

THUMBNAIL _____ *mm*